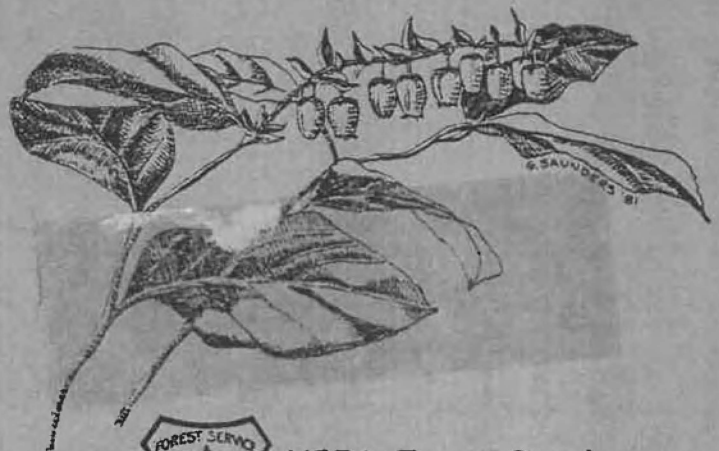


Preliminary

PLANT ASSOCIATIONS and
HABITAT TYPES of the
Mt. Baker Ranger District
Mt. Baker-Snoqualmie N. F.



USDA • Forest Service
Pacific Northwest Region

PRELIMINARY PLANT ASSOCIATIONS
AND
HABITAT TYPES OF THE
MT. BAKER RANGER DISTRICT
MT. BAKER-SNOQUALMIE NATIONAL FOREST

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PREFACE

This document represents the first approximation toward a comprehensive vegetation-site classification for this area. Organization and naming of the types should be viewed as tentative until field checking of keys and quantitative verification of types is completed. Preliminary results are presented in this form as a working tool in the development of the Area Guide. Feedback on the use of the key and type descriptions to the author is welcome.

INTRODUCTION

Vegetation is the major resource land managers manage. It covers 99% of the land and provides many resource values. It is the source of food and cover for livestock and wildlife. Timber comes from the trees of the Forest. Spiritual, recreational and esthetic values come from the majestic forests, scenic meadows and lakes and streams. Besides these direct values, it serves to hold the soil mantle in place, thereby helping to preserve many of these other values for the future. It is easily manipulated and sensitive to natural catastrophes. Yet we know relatively little about it, its ecology or the ecological implications of its management.

What kinds of vegetation are there? Where do they occur? How sensitive are they? Are they equally suitable for deer or elk or sheep habitat? How do they respond to management treatment? How fast do they grow or regrow? Which plants or animals can be found where? The answers to these questions are tied up in the complex distribution patterns of plant communities and their interactions with the environment. In order to answer these questions in a way that will satisfy sophisticated managers as well as meet the considerable load of regulations imposed on land managers today, a system is needed which helps deal with the vegetational patterns, helps us understand the complex ecosystem interactions and provides a way to apply ecological knowledge for better management.

A beginning to the solution of these problems is the description of "kinds of vegetation" in a way that is both logical and natural and will help us communicate with each other about what we need and what we know.

Forest Cover Types and Range Sites have served partially to fill this need as have various vegetation or life-zone classifications. These are single-attribute classifications that fail to serve a wide need. Moreover, probably no single vegetation or ecosystem classification scheme will suffice by itself. We need a system for classifying and describing vegetation that is internally compatible and meets the functional needs of managers.

The first step in addressing these questions is a classification and description of the potential vegetation of an area. (Daubenmire and Daubenmire 1968; Hall 1970, 1973; Franklin and Dyrness 1973; Pfister et al. 1975). The potential (or projected climax) vegetation is in greatest equilibrium with its environment and is relatively stable. It is the most easily determined stage of successional development to which all other vegetation, regardless of stage or degree of disturbance can be related. It is a reference point. It is the first step in trying to bring order to an otherwise bewildering mosaic of vegetation and vegetation-environment interactions. The basic unit of the potential vegetation is the Plant Association.

STUDY AREA

This classification includes all lands of the Mt. Baker District. It also applies to parts of the Finney Block and lands north of the Suiattle River in the Darrington District which were not covered by previous reports. However, acreage and percent-of-area values apply to the Mt. Baker District only. The Mt. Baker District includes about 510,000 acres of which about 424,00 acres are to forested. This is broken down into the Western Hemlock zone - 93,000 acres (18%), Pacific fir zone - 212,000 acres (42%), Mountain Hemlock zone 118,000 acres (23%). The remaining 87,000 acres is meadows, rock, ice and lakes.

Prior to white settlement the area contained settlements and summer camps primarily of the Nooksack and Skagit tribes. The Thompsons to the north and Okanogan, Methow and Chelan tribes from the east, also, apparently travelled into the area (Schmierer 1983). The Nooksack Indians were known to cultivate many plants for food. They also used fire to help maintain the prairies from which they gathered broken, camas, cow parsnip and wild carrot (Schmierer 1983).

The earliest white man to set foot into this area was Alexander Ross who in July 1814 crossed the mountains at Cascade Pass in search of a trade route from the Okanogan to Puget sound. He encountered a "hurricane" which blew down many trees and forced him to return to Fort Okanogan (Roe 1980). White settlement began in the 1850's following the Point Elliot Treaty of 1855. The Northwest Boundary Survey brought surveyors up the N. Fork Nooksack in 1857-59, during which Henry Custer made a major exploration of the area north of Mt. Baker (Roe 1980).

The Fraser River gold rush of 1858 brought prospectors and merchants into the mountains to the north, some of whom probably spilled over into the Nooksack and Skagit drainages. In 1860 John Tennant, John Bennett and three others travelled up the Nooksack in search of gold (Miles, 1984). Edmond Coleman travelled up the Skagit as far as the Baker River in 1866 and returned two years later and successfully climbed Mount Baker going up the Nooksack River. By 1879 prospectors were panning gold out of the upper Skagit. Activity picked up by the 1890's as prospectors moved into the back country staking many claims. By the 1880's logging was well under way in the lower Nooksack and Skagit valleys. Cedar was a major product with numerous shingle mills operating along the Skagit and lower Nooksack by 1890.

Most of the land now part of the Mt. Baker District became part of the Washington Forest Reserve by the Forest Reserve Act of 1897, later transferred to the newly formed U.S. Forest Service in 1905. In 1924 it was renamed the Mt. Baker National Forest which included present day Mt. Baker, and Darrington Districts as well as lands now administered by the National Park Service.

Climate is moderate and precipitation is highly variable. Wet areas in the Finney Block and Loomis Mountain area (Environmental Zones 4,5,6, Fig. 9) get about 140 inches with probably a significant amount of "tree drip". The driest area is in the rainshadow of Mt. Baker and Twin Sisters (Environmental Zones 10, 11, Fig. 9). This area is also influenced by the Olympic Mountains rainshadow. Bedrock is variable including volcanics mostly around Mt. Baker and Glacier Peak, Sedimentary (Finney block) and considerable metamorphic rocks (schist and gneiss). Glacial till or glacial-fluvial material fills many of the valleys. Tephra (volcanic ash) occurs in variable quantities around the volcanoes. Topography is steep and rugged. Glacial cirques and steep lateral glacial valley walls are common. Elevations range from about 300 feet near Marblemount to 10,778 feet on the top of Mount Baker.

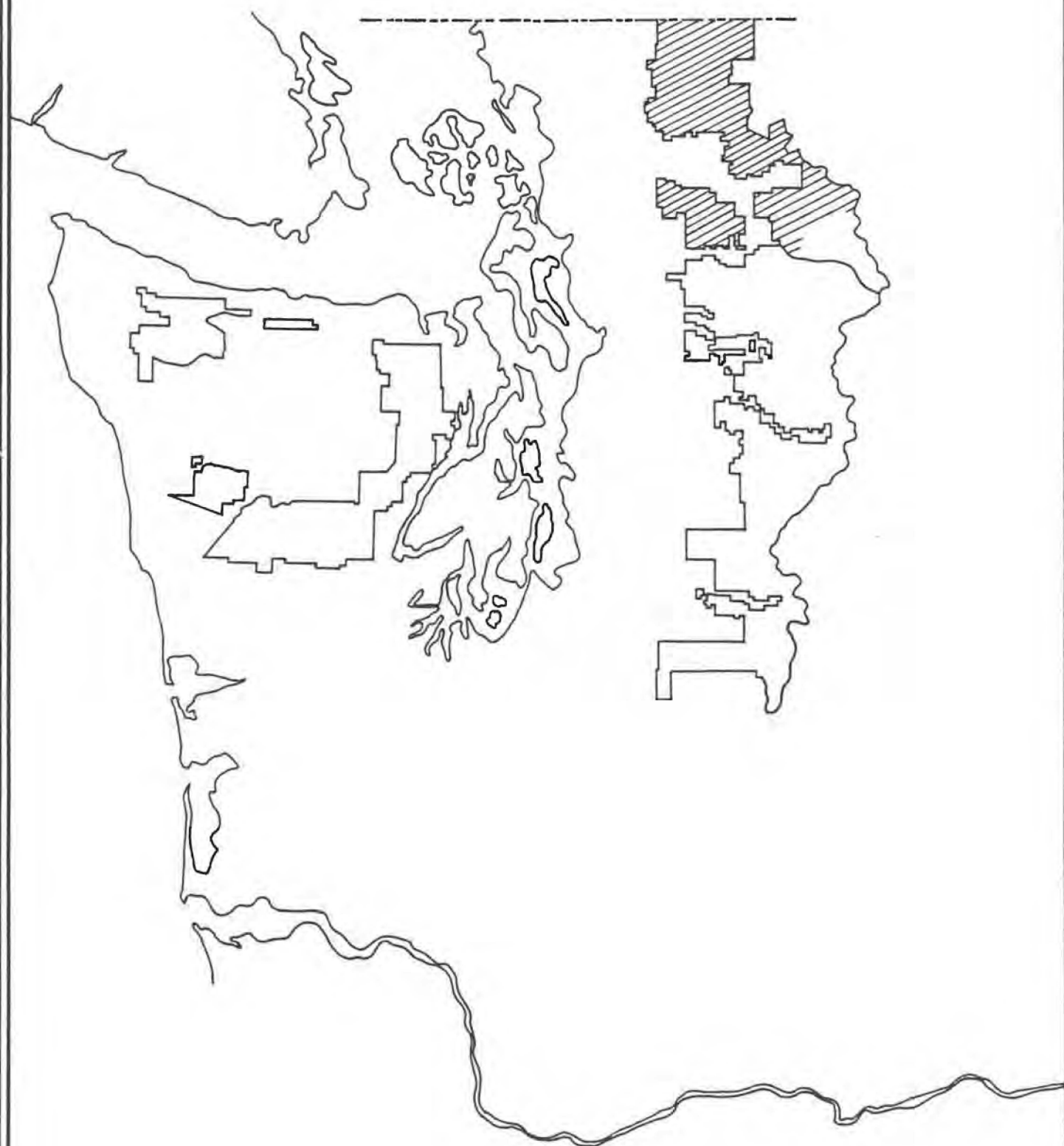


Figure 1 Map of Western Washington, Study Area Shaded.

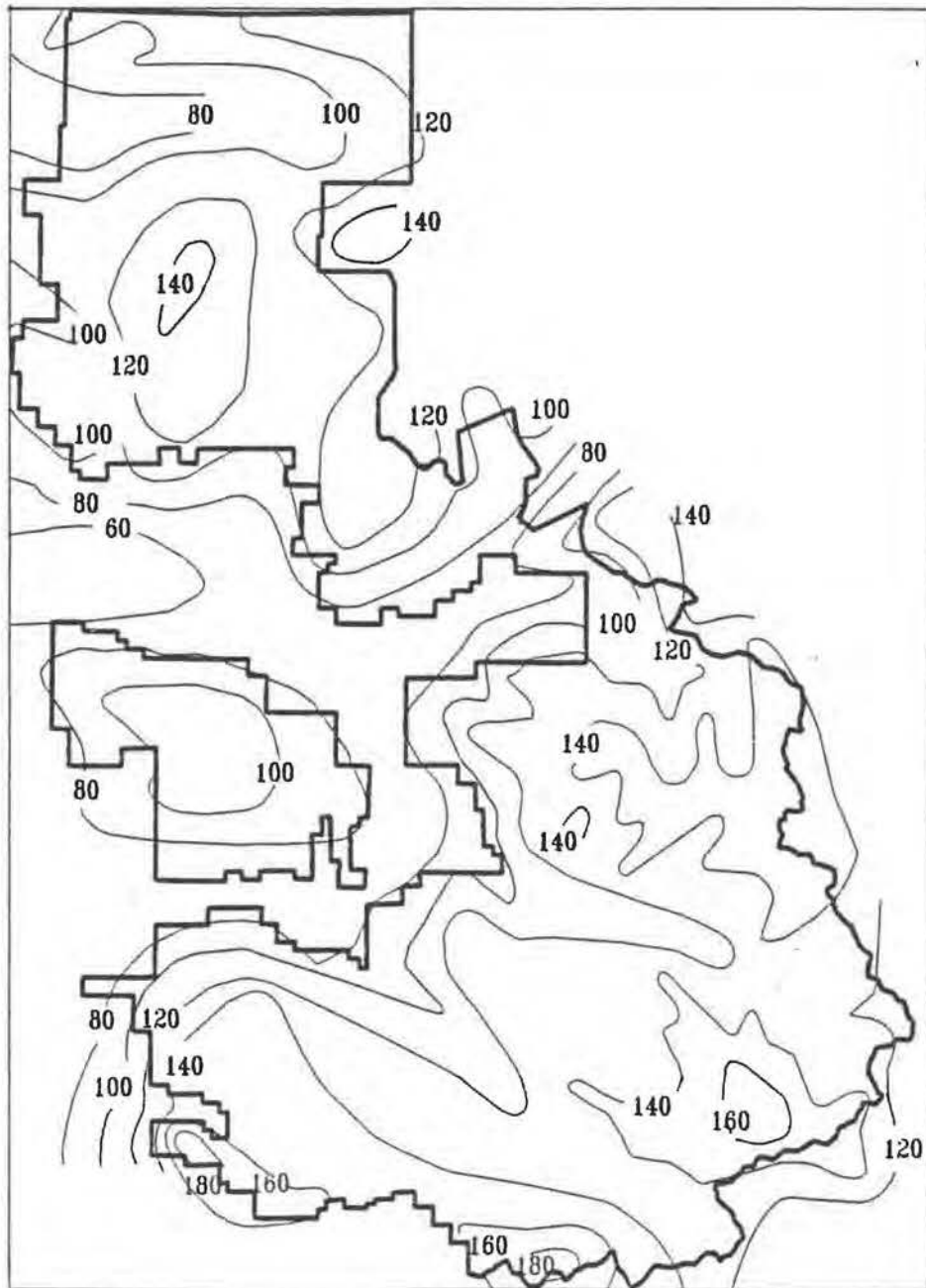


Figure 2 Precipitation Isolines for the Mt. Baker District

ECOLOGICAL PERSPECTIVE

Vegetation occurs over the landscape as a complex mosaic of various communities in different stages of development or disturbance and each responding to the gradients of environmental conditions (e.g., soil, climate, topography, temperature, etc.). Each community is the product of a different combination of environmental, biotic and historic factors.

It is this mosaic of plant communities which we manage. The complexity of these biotic, abiotic, and historical factors is so great we have only really begun to unravel the pattern and the process.

Even if the effects of disturbance could be eliminated and all communities allowed to develop to the point where they are believed to be in equilibrium with the environment (climax?), the vegetation would still probably represent a continuum of communities when measured along a uniform environmental gradient over large distances. However, for any geographical area (in the western U.S. at least) environmental gradients are not uniform, and in fact marked discontinuities are common, with certain combinations of environmental factors occurring in the landscape more frequently than others. The segments of the vegetational continuum associated with those environmental "combinations" also occur more frequently. Therefore, although we recognize the continuum nature of vegetation, we analyze and portray it as natural segments or "types". These we call community types, or Associations. If we are dealing with or analyzing seral communities or communities for which the end point of succession (climax) is unknown or cannot be projected we use the community type concept. If we are referring to the projected climax potential of a community, we refer to it as an Association. This is not to be misunderstood that we believe that these types are sacred or even inherent units of the vegetation. We view these "types" as somewhat arbitrary but statistically derived segments of the vegetational continuum for this area.

The typical approach allows us to break up a very complex array of plant communities into more understandable units. Such units can then be used to communicate with others, to catalog and store information about the vegetation (such as productivity, regeneration response, etc.) stratify the vegetation and the landscape into relatively homogeneous units for the purposes of other studies (such as potential timber productivity, fertilizer response or successional patterns) or to aid in the study of the relationships between vegetation and the physical environment.

The distinction between the existing vegetation (community types) and the potential (Associations) is fundamental to the approach used in this study. The existing vegetation is what we manage. However, to understand the potentials of a particular community and to understand its relationship to the physical environment (the forces that drive the ecosystem), the existing community must be related to some reference point in time. Preferably this reference point (successional or developmental stage) will be in relatively stable equilibrium with its environment. The one successional stage that does this is the "climax" stage. We do not know for sure what the climax stage is for a community or for an area because of problems of time scale, climatic changes and fire. We

discount the effects of fire, assume that climatic changes are insignificant (poor assumption at high elevations) and that the community which could develop in a time frame of about 1000 years represents the "Climax". We do not have an abundance of 1000 year old communities to sample. Therefore, we use the projected climax potential as an estimate of the climax stage. To do this we project the relative abundance of trees ahead in time to about 1000 years using stand conditions in the oldest sampled communities and knowledge of the tolerance of trees. Secondly we assume that the understory (ground vegetation) component has come to equilibrium with the environment by about 200 years. Therefore, the understory component of all communities sampled which are 200 years or older can be used in analyzing and describing the Association (Projected Climax community type).

CLASSIFICATION HIERARCHY

The classification hierarchy used in delineating and defining units of vegetation (potential and actual) and units of land with similar ecological characteristics is intended to be the same that is being proposed for national usage by the Interagency Resources Evaluation Team (RET).

The classification hierarchy emphasizes potential vegetation at the level of the Plant Association as the basic unit. Plant Associations are abstract units of the potential vegetation which are characterized by the same overstory and understory dominants. Phases are finer subdivisions of the Association based on secondary or indicator species, and Series are aggregations of Associations with the same overstory dominants. Kuchler's Potential Vegetation Types (KPVT's) are equivalent to mapped series or groups of ecologically similar series. Regional formations (Biomes) are the next highest level above series in the currently proposed national classification.

The aggregate of all units of land capable of supporting a single plant Association (at climax or stable-state) is called a Habitat Type. A Habitat Type is named for the Plant Association which characterizes it and may also have phases named for the Association phase.

Ecological Land Units (or Ecological Response Units) are areas of land with similar responses to treatment and reactions to the environment and are at least partially defined and delineated on the basis of the Habitat Type.

In addition to the potential vegetation types, it is also useful to recognize plant community types and plant communities. Plant communities are the actual entities which occupy the landscape. The plant community type is an abstract aggregation of similar communities which may or may not reflect their successional condition. However, a climax community type is considered synonymous with Plant Association. The classification hierarchy is outlined in Figure 3.

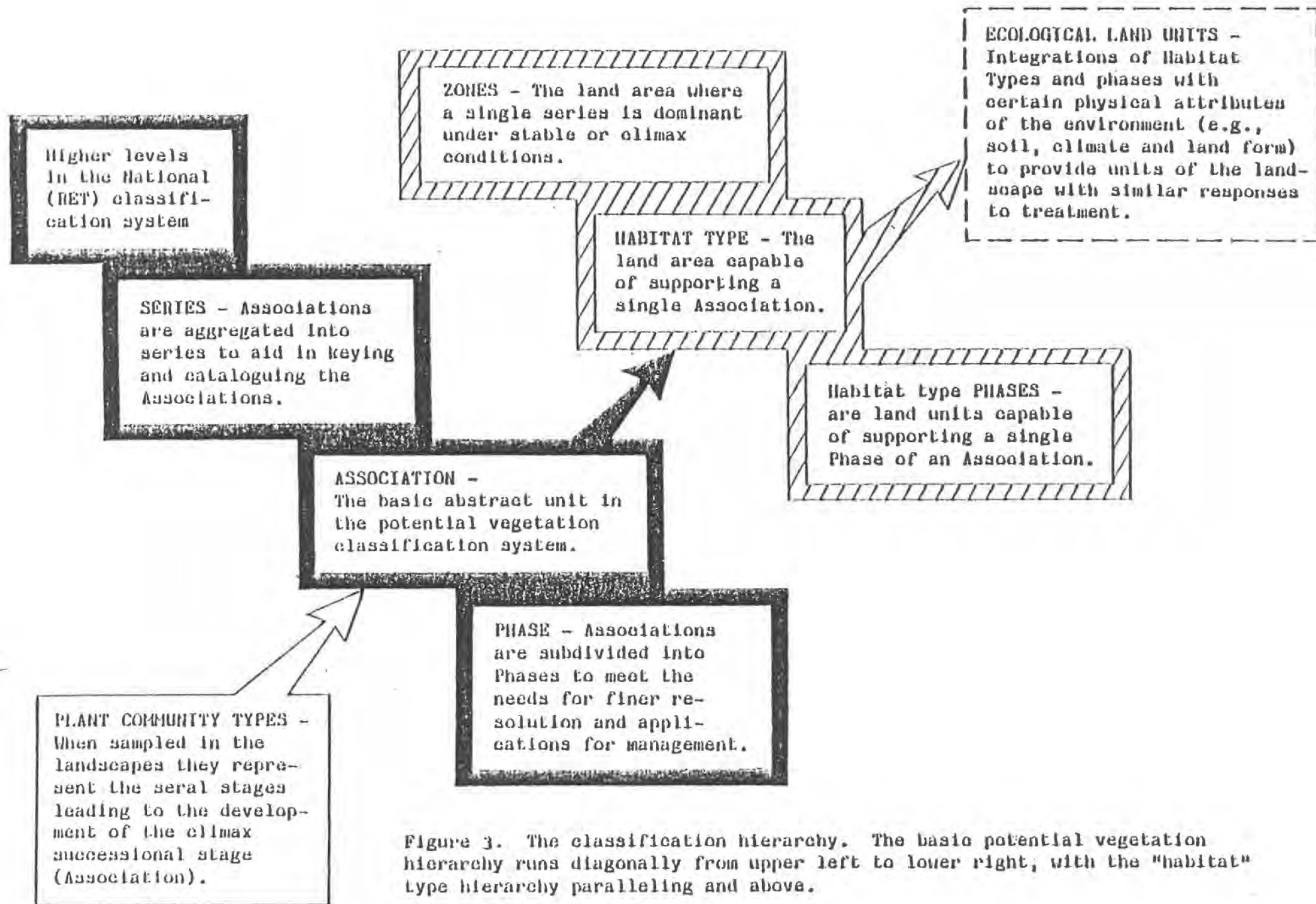


Figure 3. The classification hierarchy. The basic potential vegetation hierarchy runs diagonally from upper left to lower right, with the "habitat" type hierarchy paralleling and above.

FIRE HISTORY

Settlement era fires (1840 - 1920) have occurred in many of the areas where early logging or mining activities took place. Some areas were burned around Glacier, up Glacier Creek and up the Nooksack River following logging but most of the second growth in this area is the result of early logging. Not all of these early fires were associated with logging. In 1914 the First Chance Mine Fire burned about 2000 acres of timber along the south slopes above Nooksack falls (Schmieder 1983). Other areas further up river burned about this time also. In the Silesia Creek drainage and on Goat Mountain fires burned in about 1900 and the Lone Jack Mine nearby burned in 1907 (Schmieder 1983). The age of the Barometer Mountain Fire is yet undetermined but is ca. 1950.

In the Baker Lake basin a fairly extensive fire burned about 1830 (perhaps at the same time as the Sank Prairie fire near Darrington ca. 1925 Henderson and Peter, 1984). The evidence of "Massive fires" and ".....holocausts the like of which haven't been seen since....." from the legendary Joe Morovitz was not found. An area in the vicinity of Marovitz (sic) ranch 2000-3000 acres burned about 1900. Several areas also burned along the Upper Skagit. The south slope of Sauk Mountain, Lookout Mountain and Helen Buttes burned ca. 1868 (not 1825 as previously thought). Much of the Lower Bacon Creek drainage burned ca. 1845. The Finney block appears to be without fire during the settlement period except in the far northeast corner (see Henderson and Peter 1984). Up the Suiattle drainage several fires burned along the south slopes of Huckleberry and Green Mountain. One of them was ca. 1825. Farther up the Suiattle there is evidence for one or more fires ca. 1900 (?) and 1868.

Evidence for major pre-settlement fires can be found throughout this area. However, the fires ca. 275 and 317 years ago which were common to the south show up in small amounts up here. Fragments of stands from the fire ca. 1710 are found in the Suiattle and Upper Skagit. The fire ca. 1668 may have been more extensive also burning up the North Fork Nooksack (Church Mountain), Sauk Mountain, Upper Cascade Rivers and around the fringe of the Finney Block. It also burned well up the Suiattle, but much of this area was reburned during settlement and prospecting fires.

Evidence for an extensive fire from 450 - 480 years ago is found in much of the Finney Block and the Cascade River. This fire (or burning period) was very extensive occurring at least as far south as Mt. Ranier and into the Olympic Mountains.

The earliest big fire that can be traced with any certainty occurred about 675 years ago. We believe this marked the end of a major warm-day period - the Medieval Optimum which was characterized by numerous and extensive fires in Western Washington. Trees which apparently date this big fire (mostly Douglas-fir) occur up the north and middle fork of the Nooksack, in Baker Lake Basin, in the Finney Block, Oakes Peak, Illabot Creek, Downey Creek, Sulphur Creek and the Upper Suiattle.

In addition to trees which date from the big fire about 675 years ago (ca. 1310 a.d.) There are trees which predate this period. Douglas-fir or mountain hemlock trees which are older were found up Canyon Cr., near Pinus Lake and Welcome Pass, Near Blue Lake (Pacific silver fir and western hemlock stumps), Finney Block, Upper Cascade River, Illabot Cr., and in the Upper Suiattle.

SAMPLING PROCEDURES AND ANALYSIS

The vegetation was sampled using 500 m² reconnaissance plots. These plots were used to acquire data on vascular plant species presence and cover. The taxonomic authority used was Hitchcock et al. (1955-1969). Hitchcock and Cronquist (1973) was used for field identification. Data were also taken on the physical site features (slope, aspect, elevation, and topography) plus measures of stand structure, age and productivity. Plot locations were marked on topographic maps. Details of plot layout, coverage estimates and parameter codes are not presented here, but are available on request. In general, they follow the procedures used by Henderson 1974, Henderson et al. 1979, Franklin et al. 1979, and discussed in Franklin et al. 1970, and Henderson 1979.

Sampling was done to provide an adequate coverage of all areas, stand ages and vegetation types at an intensity of at least one plot per section of land (Figure 4). To do this, several sampling strategies were used. Initially, we tried to put one plot near the center of each section of land where road or trail access allowed. Since sampling of old-growth communities was the primary objective, often the most accessible stand of old-growth near the center of a section was used.

Where this sampling scheme was not feasible, road, trail or cross-country transects were used with a predetermined sampling interval (e.g., each 1/2 mile, 1/2 hour, or 300 feet elevation). Lastly, if this did not prove appropriate for the vegetation at hand, subjective bias was used to allow sampling of communities too small or irregular to be picked up in the other strategies. Also, plots were often established in clusters (most often as pairs) when it would be useful for subsequent analysis to show, for example, the vegetation on two or more contrasting aspects or to sample two or more different age classes contiguous or near enough to each other to represent the same kind of site.

The resulting sample of 951 plots in the study area (including 487 old-growth forest plots, 127 non-forest plots and 337 seral forest plots) represents a combination of systematic and subjective sampling strategies (Figure 4). The objective was to ensure optimum representation in the sample of the variability in vegetation in the area. This provided us with a sampling intensity of 1.0 plots/section.

Identification of plant Associations used computer assisted sorting and clustering routines (Volland and Connolly 1978). Only old-growth and climax communities were used in this analysis. Association and similarity tables and cluster analysis dendrograms were generated to help group climax communities and projected climax communities into types. Each type being comprised of and characterized by communities with relatively homogeneous composition. Although several different approaches are used, and each one aggregates plots into clusters or types, they ordinarily do not completely agree. The final marrying of approaches becomes subjective and controlled largely by the biases and perspectives of the classifier. However, the objective is a classification of climax community types (Associations) with the greatest overall within class similarity, the greatest between type dissimilarity and the best application to management problems.

Figure 4A. Map of Plot Locations - Glacier

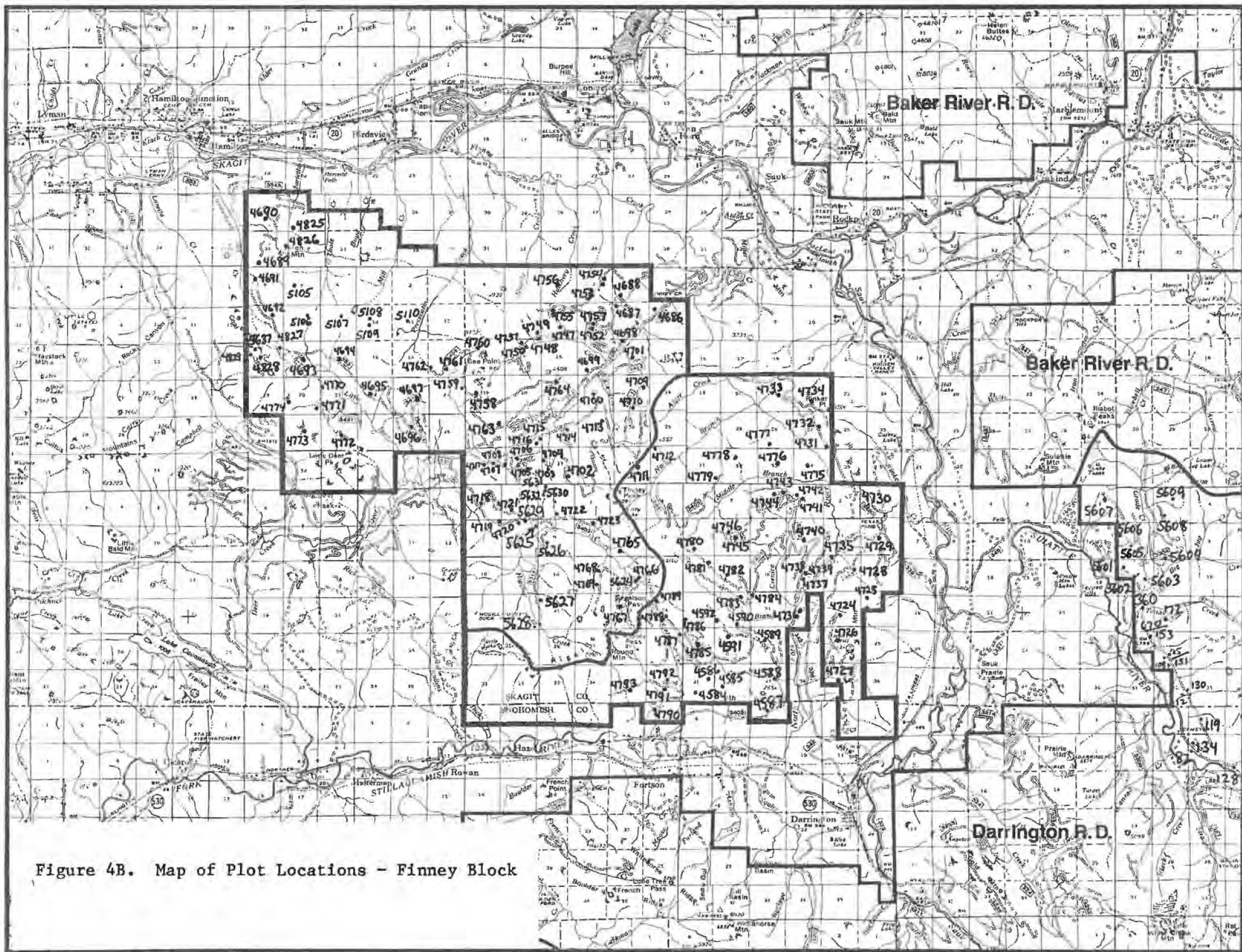


Figure 4B. Map of Plot Locations - Finney Block

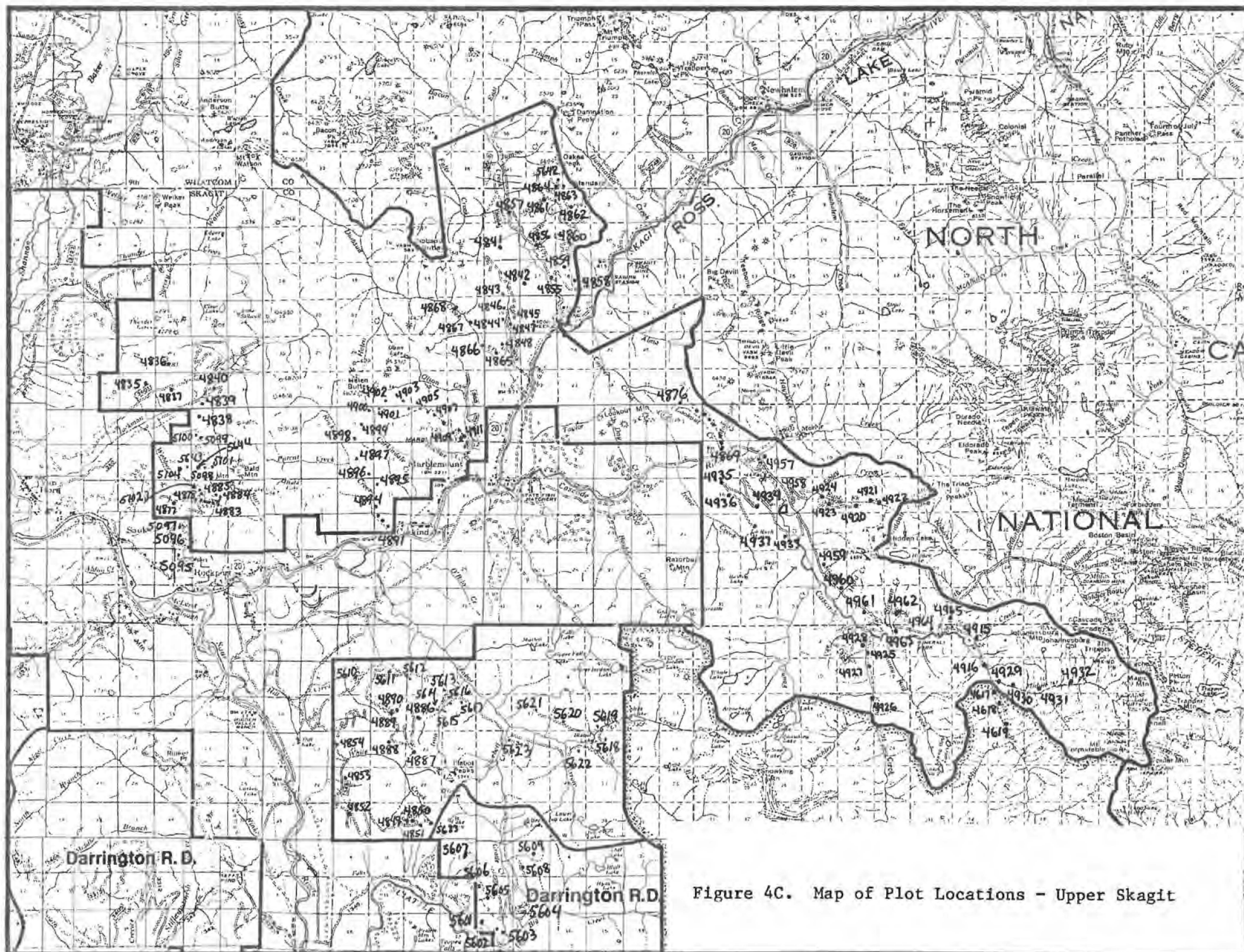


Figure 4C. Map of Plot Locations - Upper Skagit

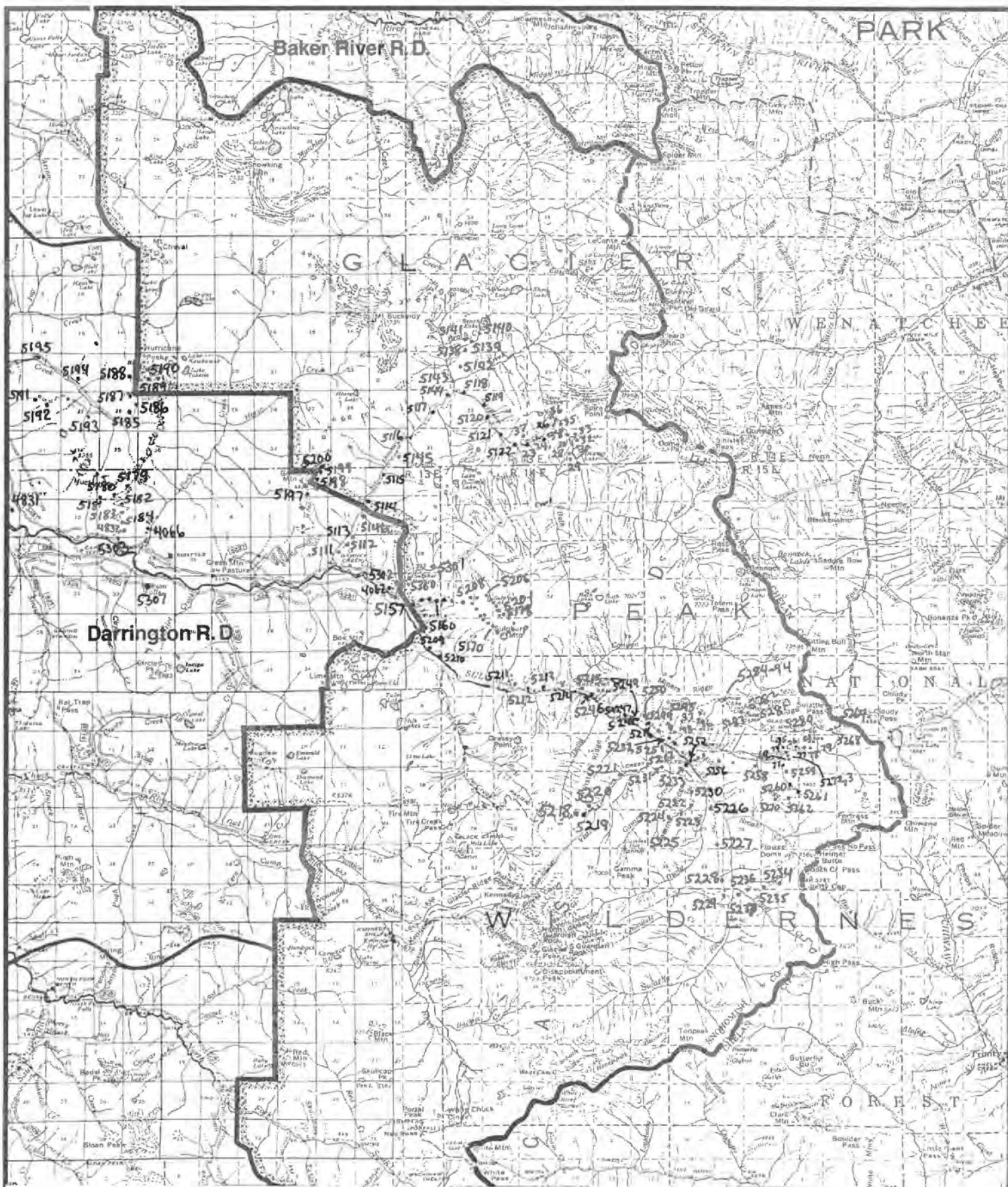


Figure 4D. Map of Plot Locations - Glacier Peak Wilderness

THE FOREST SERIES

The first level in the classification hierarchy below the formation is the series. It is also the first level that is useful at the forest planning or project level.

Series are broad units of the potential (projected climax) vegetation which are identified by one (or more) dominant overstory species. In this area we recognize three Forest series - western hemlock, silver fir, and mountain hemlock. The area of ground where these series can occur are called zones and go by the same names, i.e. the western hemlock zone is the area where the western hemlock series is potentially dominant, etc.

Typically, in the near-climax state in temperate forest vegetation more than one tree species dominates. This is understood in naming a series even when we use a single tree species. For example, in the silver fir series western hemlock and silver fir will codominate. In the mountain hemlock zone, mountain hemlock and silver fir will codominate. The distribution and location of the western hemlock, silver fir and mountain hemlock zones are shown in Figures 8A, 8B and 8C.

Figures 5 and 6 show the aspect-elevation relationships used to help construct the map of the zones in Figure 8. The aspect-elevation relationships vary relative to precipitation and general climatic patterns. These apply to the areas or zones shown in Figure 8. Curve 4 (Figure 5), for example applies to the area shown in Figure 8 as Zone 4, curve 6 applies to the Zone 6, etc. These figures show that the elevation of the vegetation zones gets higher in drier areas and lower in wetter areas.

The first step in identifying an Association or habitat type is to identify the series. The series name becomes the first part of the name of Association or habitat type just as the genus is the first part of the species name in plant taxonomy.

The following key will allow the user to identify the series. It can only be used on stands or communities for which the projected climax composition is known or can be estimated. Further interpretation is often necessary to apply this classification to seral (second growth) communities.

Key to the Forest Series

1. Mountain hemlock (Tsme) $\geq$ 10%
cover in old-growth or projected
climax condition. Tsuga mertensiana Series p. 23
1. Not as above. (2)
 2. Silver fir (Abam) $\geq$ 10% cover
in old-growth or projected climax
condition Abies amabilis Series p. 38
 2. Western hemlock (Tshe) $\geq$ 10%
cover in old-growth or
projected climax condition. Tsuga heterophylla Series p. 54

TABLE I. Successional Role of Tree Species by Plant Association

	Alru	Psme	Abpr	Tshe	Thpl	Abam	Chno	Tsme	Abla2
Tshe/Gash	+	S		C	c				
Tshe/Bene	s	S		C	c				
Tshe/Dep.	s	S		C	c				
Tshe/Pomu	S	S		C	c				
Tshe/Vaal	s	s		C	c	+			
Tshe/Opho	s	s		C	C	+			
Abam/Gash		s	+	C	c	C			
Abam/Opho				C	c	C			
Abam/Vaal		s	+	C	+	C	+	+	
Abam/Vame		+	S	C		C	+	+	
Tsme/Opho						C	c	C	
Tsme/Vaal				+		C	c	C	
Tsme/Vame		+	s	+		c	+	C	s
Tsme/Dep.			+	+		c	c	C	s
Tsme/Clpy-Blsp						c	c	C	
Tsme/Rhal						+	+	C	
Tsme/Phem-Vade						+	+	C	s

Where: C = Major climax species
c = Minor climax species

S = Major seral species
s = Minor seral species

+ = May occur

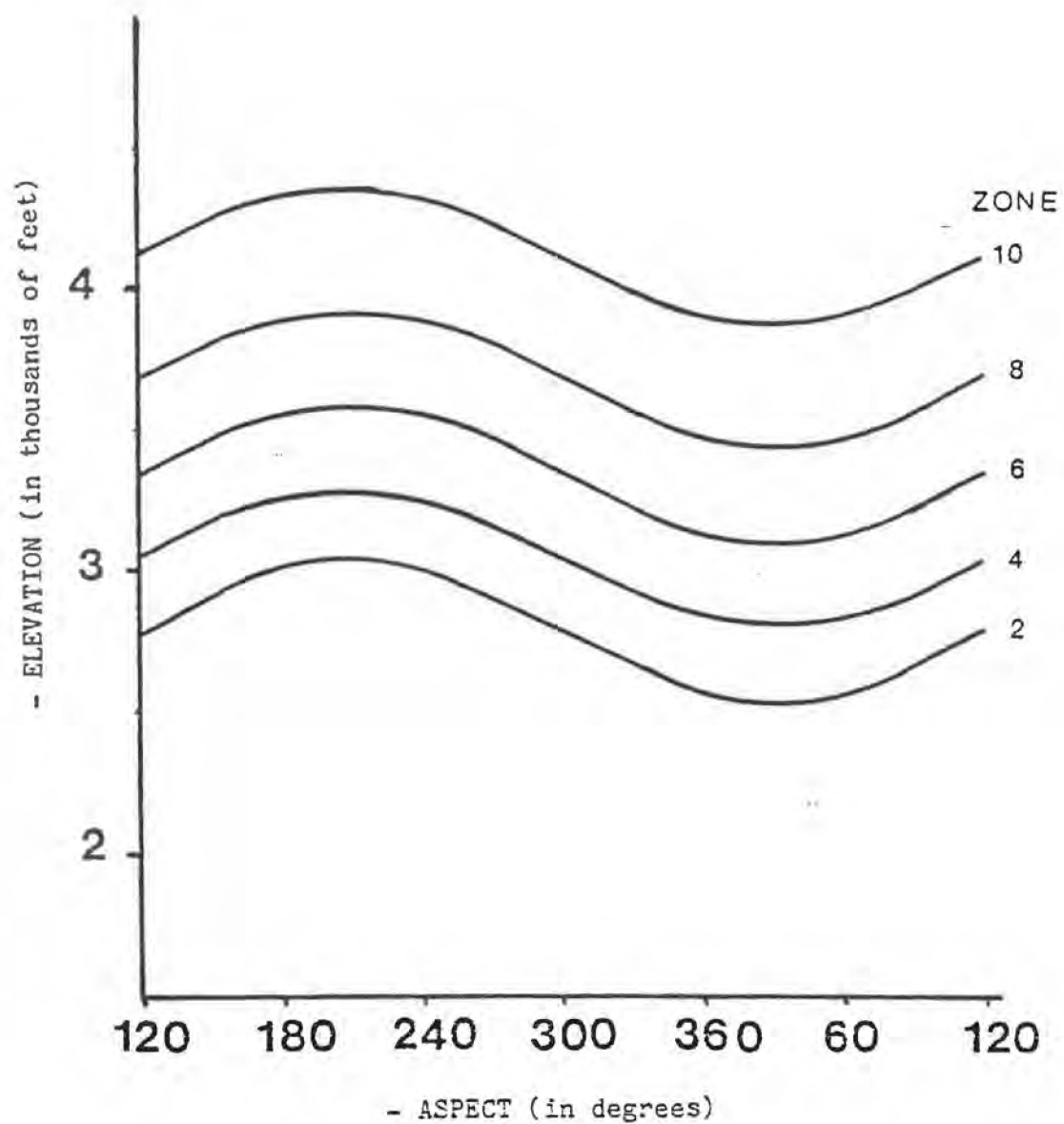


Figure 5. Aspect - Elevation Curves for the Upper Boundary of the Abies amabilis zone (Lower boundary of Tsuga mertensiana zone.)

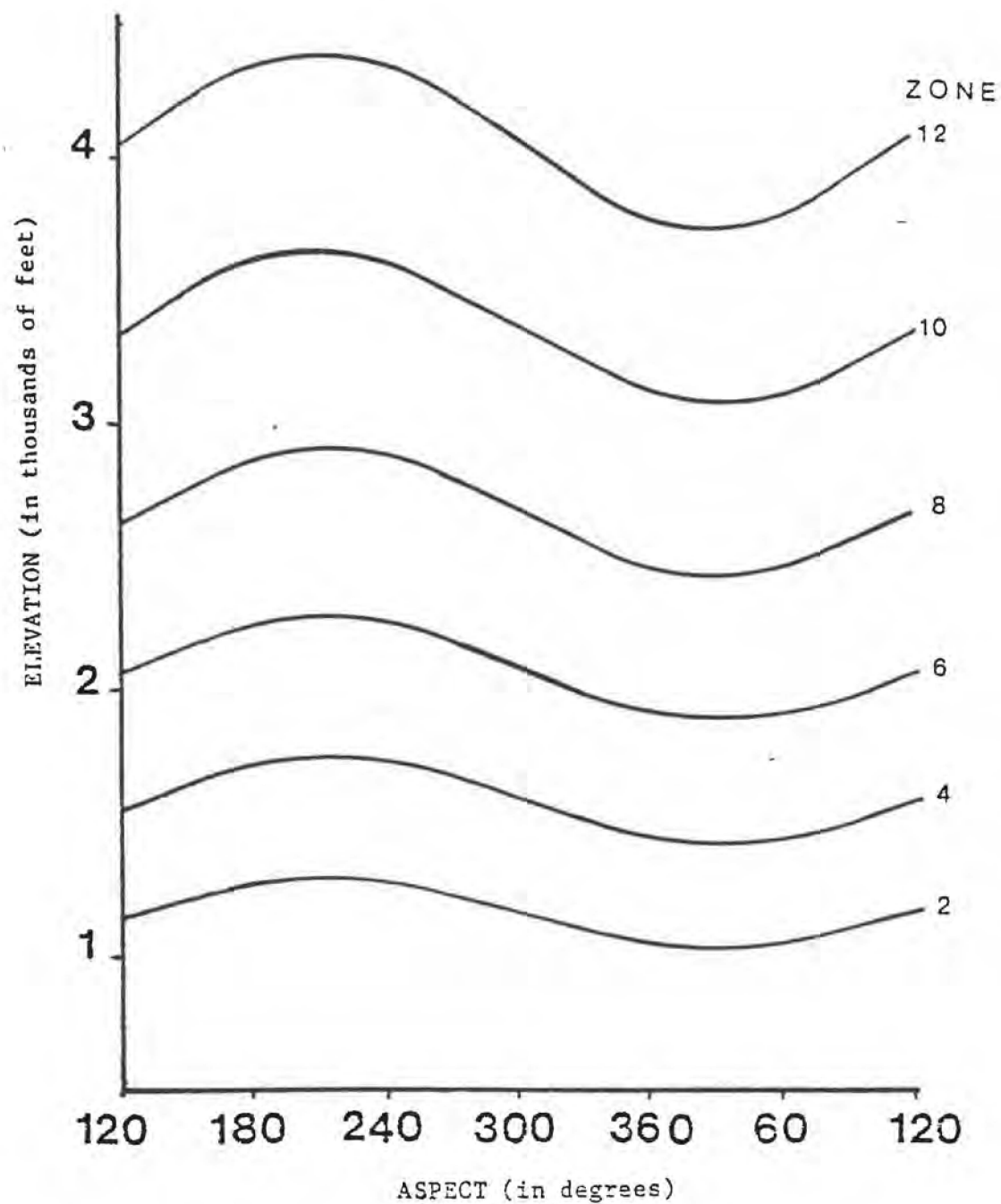


Figure 6. Aspect-Elevation curves for the lower boundary of the Abies amabilis zone (upper boundary of the Tsuga heterophylla zone).

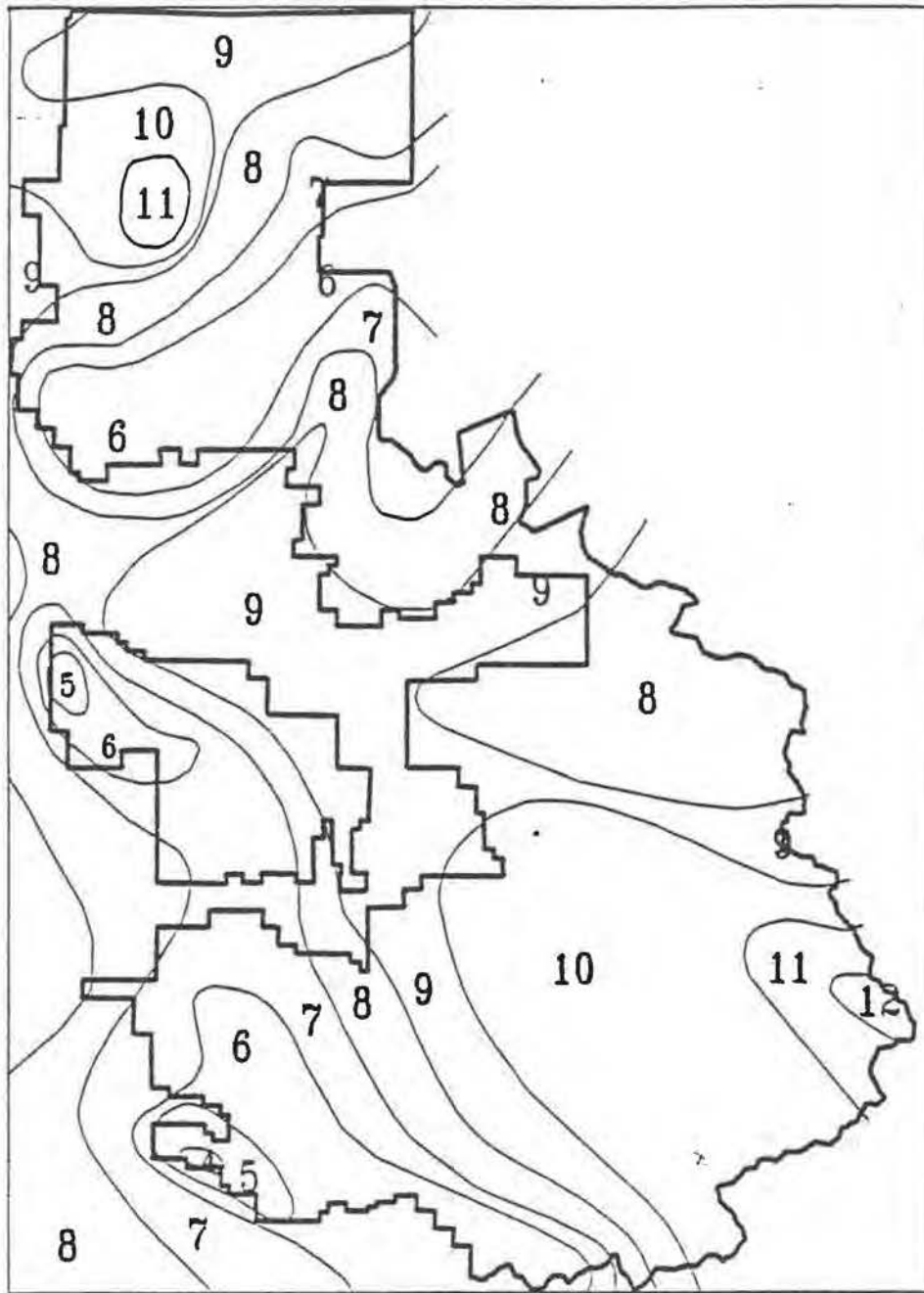
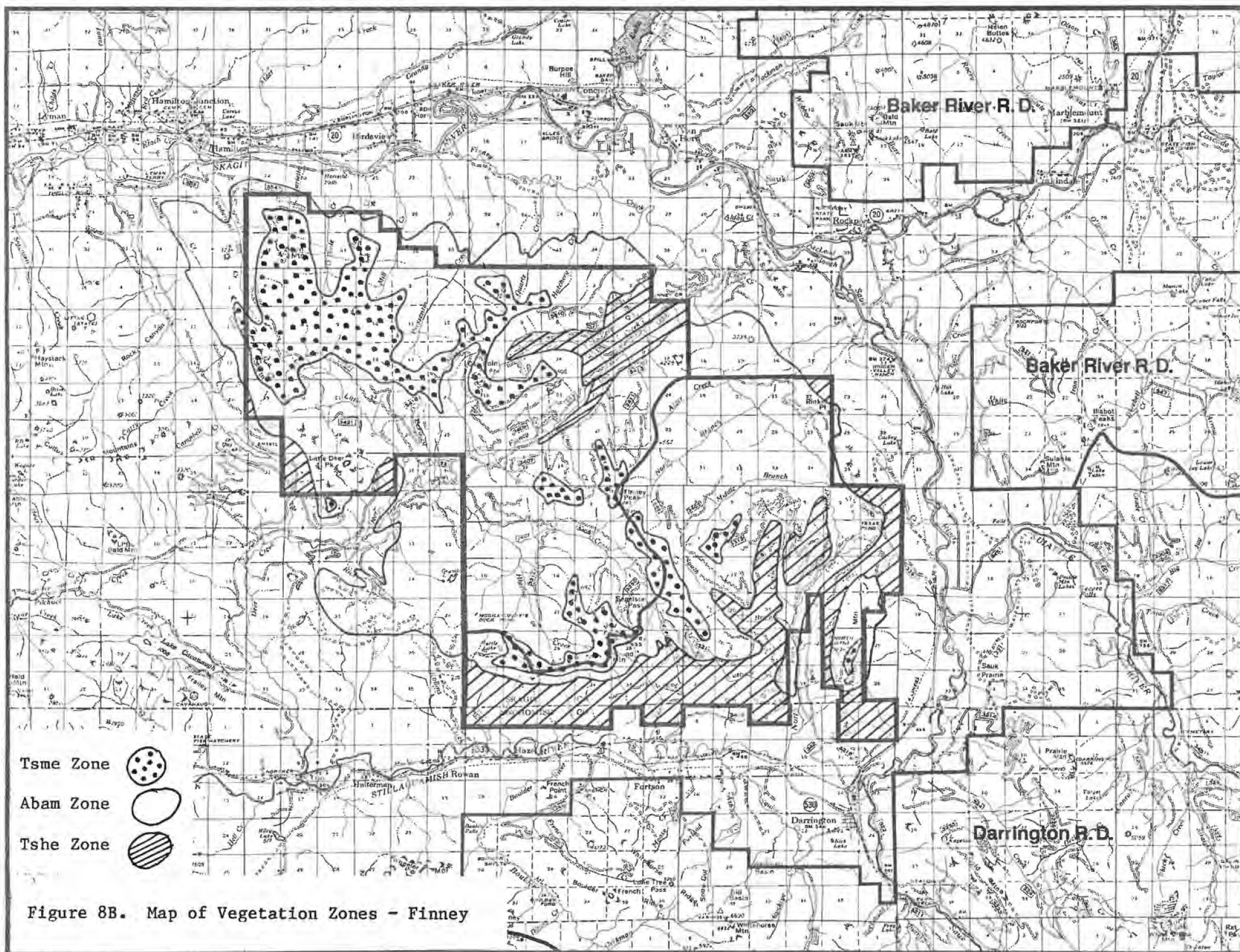
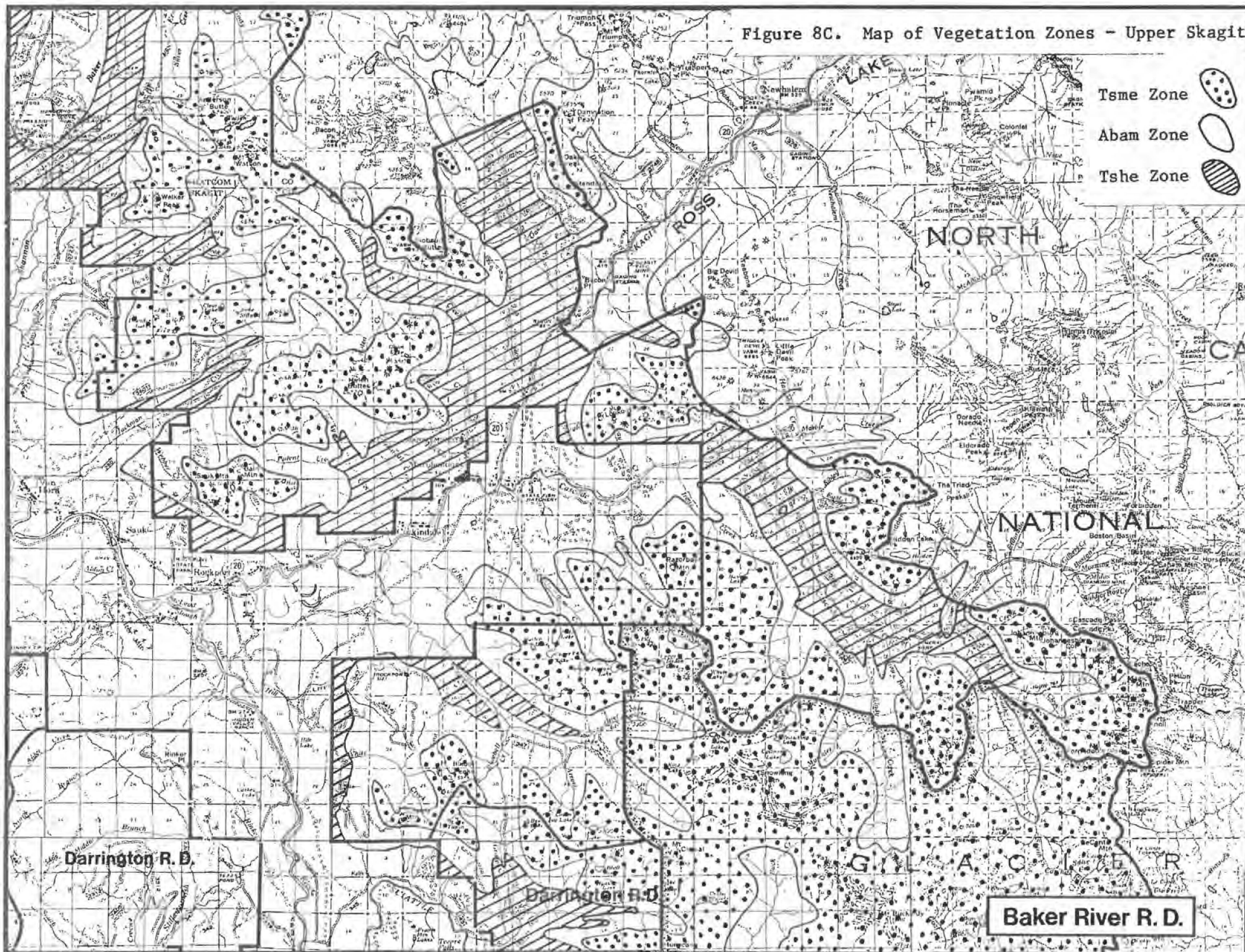


Figure 9 Map of Environmental Zones, Mt. Baker and Darrington Districts. Lower numbered zones are wetter and vegetation zones (figure 10) occur at lower elevations. Higher zones represent drier (rain shadow) areas.



Figure 8A Map of Vegetation Zones - Glacier





Tsuga mertensiana (Mountain hemlock, Tsme) Series

The Tsuga mertensiana series occupies an area of ground (i.e. the Tsme zone) equivalent to about 23% of the study area (Figure 8). It occurs above about 3300 feet (1000 m.) in wetter areas and about 4200 feet in Environmental Zone 10. It is nearly absent in Zone 11 and 12. (Figure 7). As used here it includes both the closed forest subzone and the portion of the Parkland subzone with trees. The meadow types, predominantly the heather-huckleberry and black sedge types (Henderson 1974), sometimes included in the mountain hemlock zone are briefly discussed on pages 68 and 80 of Henderson and Peter (1982b).

The Tsme zone is characterized by more than 100 inches (254 cm) of precipitation, cold maritime temperatures and considerable cloudiness throughout the year. Most of the precipitation comes as snow and results in a deep winter snowpack, usually more than 10 feet (3.3 m) deep which persists well into the spring. This late lying snowpack, while retarding the growth of trees and greatly affecting the understory species, is also a very significant source of ground and stream water through the summer. Toe slopes at low elevations may be more moist and therefore more productive if fed by ground water from the mountain hemlock zone.

Many avalanches originate in the Tsme zone or higher. Steep open slopes without trees are where most start. Sometimes these areas are recent burns which have not regenerated to trees. The long regeneration lag (20-150 years) here makes some of these avalanche areas a relatively permanent feature of the landscape. Several of the burns from about the turn of the century are still prime huckleberry (Vame) picking areas. The steeper parts of these areas are also good areas for avalanches to start. A possible use of local silvicultural expertise which is not commonly thought of might be to accelerate restocking of some of these areas to reduce avalanche hazard; for example along the Snoqualmie Pass Highway in the old Granite Mountain burns.

The temperature regime here is probably a more significant environmental factor than the moisture pattern, except perhaps for the physical forces of the heavy snowpack itself. Cold soils due to the lower ambient air temperature and the depth and lateness of the snowpack probably precludes many lower elevation species here. Summer soil temperatures at a depth of about 20cm (8") seldom get above 12° C (54° F). This upper zone of the soil is maintained at or near freezing temperatures by the insulating effects of the snowpack throughout the winter, and warm very little until the snowpack is gone. Then there is a rise in soil rooting zone temperatures until cool rains resume in the fall. This short period of time of soil warming is a significant ecological factor in the Tsme zone. In addition to the cold soil temperature in the rooting zone, the effect is compounded by the occasional high soil surface temperatures. This extreme difference in temperature within only a few centimeters at the soil surface is very harsh environment for plants to germinate and become established.

Soils are variable, but generally typical of high mountainous areas. They are mostly poorly developed, cold soils, developed from steep, shallow and unstable colluvium, remnants of alpine glacial till or residual material. Most of the stands sampled occurred on granite bedrock.

Due to the short growing season and cold temperatures, timber stand growth and tree re-establishment (succession) following disturbance, are generally quite slow. The mean tree height (based on silver fir or mountain hemlock) expected at age 100 years was calculated to be 59 ft. (18 m) with a range of individual stands from 25 to 110 (8-34 m). This is based on tree age, however, and not total stand age. Since there is often a long establishment period following disturbance of 30 to 150 years in this zone, and often very suppressed height growth in the early years, this may represent a substantial overestimate of what might be achieved starting from the time of disturbance. Basal area for these same stands (200-700 years estimated ages) averages 316 ft²/ac (73 m²/ha).

Ten Tsme Associations are recognized based on sampling of 173 plots in this area. They are Tsme/Vaal, Tsme/Phem-Vade, Tsme/Vame, Tsme/Depauperate, Tsme/Rhal-Phem, Tsme/Rhal-Vame, Tsme/Opho, Tsme/Cabi, Tsme/Vaal-Vame, Tsme/Tiun-Stro. Of these Tsme/Vaal is the most common, occurring on about 30% of the mountain hemlock zone in this area. The next most common Associations are the high elevation parkland type Tsme/Phem-Vade and the dry Tsme/Vame types. Tsme/Rhal is a type of coldwet places in the highest precipitation area representing less than about 10% of the Tsme zone.

Key to the Associations in the Tsuga mertensiana Series.

1 Devils club (OPHO) $\geq 5\%$ cover.....	TSME/OPHO	p. 29
1 Devils club (OPHO) $< 5\%$ cover.....	(2)	
2 Marsh marigold (CABI) $\geq 10\%$ cover.....	TSME/CABI	p. 29
2 Marsh marigold (CABI) $< 10\%$ cover.....	(3)	
3 Big huckleberry (VAME) $\geq 20\%$ cover.....	(4)	
4 Red heather (PHEM) plus blueleaf huckleberry (VADE) $\geq 25\%$ cover.....	TSME/PHEM-VADE	p. 31
4 Red heather (PHEM) plus blueleaf huckleberry (VADE) $< 25\%$ cover.....	(5)	
5 Alaska huckleberry (VAAL+VAOV) $\geq 10\%$ cover.....	TSME/VAAL-VAME	p. 33
5 Alaska huckleberry (VAAL+VAOV) $< 10\%$ cover.....	TSME/VAME	p. 33
3 Big huckleberry (VAME) $< 20\%$ cover.....	(6)	
6 Foamflower (TIUN+TITR) plus rosy twisted stalk (STRO) $\geq 10\%$ cover.....	TSME/TIUN-STRO	p. 29
6 Not as above.....	(7)	
7 White rhododendron (RHAL) $\geq 5\%$ cover....	(8)	
8 Red heather (PHEM) $\geq 10\%$ cover.....	TSME/RHAL-PHEM	p. 31
8 Red heather (PHEM) $< 10\%$ cover and big huckleberry (VAME) $\geq 5\%$ cover.....	TSME/RHAL-VAME	p. 30
7 White rhododendron (RHAL) $< 5\%$ cover....	(9)	
9 Red heather (PHEM) plus blueleaf huckleberry (VADE) $\geq 25\%$ cover.....	TSME/PHEM-VADE	p. 31
9 Red heather (PHEM) plus blueleaf huckleberry (VADE) $< 25\%$ cover.....	(10)	
10 Big huckleberry (VAME) $\geq 10\%$ cover.....	(11)	
11 Alaska huckleberry (VAAL+VAOV) $\geq 10\%$ cover.....	TSME/VAAL-VAME	p. 33
11 Alaska huckleberry (VAAL+VAOV) $< 10\%$ cover.....	TSME/VAME	p. 33
10 Big huckleberry (VAME) $< 10\%$ cover.....	(12)	
12 Alaska huckleberry (VAAL+VAOV) $\geq 10\%$ cover.....	TSME/VAAL	p. 35
12 Alaska huckleberry (VAAL+VAOV) $< 10\%$ cover.....	(13)	
13 Understory (shrubs and herbs) $\leq 10\%$ cover.....	TSME/Depa	p. 37
13 Understory (shrubs and herbs) $< 10\%$ cover.....	Rare or undescribed type or seral or disturbed condition.	

Table II. Environmental and Productivity Values for Associations in the *Tsuga mertensiana* Series.

	TSME/ PHEM-VADE n=11	TSME/ RHAL-PHEM n=2	TSME/ VAME n=35	TSME/ VAME-VAAL n=14	TSME/ RHAL-VAME n=9	TSME/ DEPA n=12	TSME/ TIUN-STRO n=4	TSME/ VAAL n=43	TSME/ OPHO n=2
ELEVATION (ft)	5425±451 ¹	5043±521	4763±436	4225±611	4683±834	4904±548	4550±280	3661±506	3345±134
ASPECT (most common)	ALL	W	SW,SE	SW,SE	ALL	SW	W,S	ALL	SW
SLOPE (%)	44±33	24±12	43±21	37±16	30±19	39±33	64±29	33±19	25±5
TOPOGRAPHIC MOISTURE ²	4.3±1.4	5.0±.8	4.7±1.3	5.1±1.0	4.8±1.6	4.2±1.4	5.0±1.0	5.3±1.4	8.0±0
SOIL TEMPERATURE ³	8.1±2.2	7.3±0	7.7±1.9	7.6±2.1	6.9±2.4	9.2	6.0±2.7	7.4±1.4	9.6±2.5
TOP HEIGHT ⁴ (ft)	56±24	71±23	113±32	116±21	92±22	101±42	138±17	123±23	185±4
BASAL AREA ⁴ (ft ³ /ac)	210±119	188±62	324±93	310±106	311±97	436±100	391±68	305±92	268±114
SITE INDEX ⁵	51	57	85	89	69	82	103	92	142

1 Values are ± one standard deviation.

2 Relative scale with 1=no water holding capacity and 9=aquatic. Reflects topographic redistribution of groundwater.

3 Mean soil temperature at 8" (20 cm.) in centigrade measured during the summer months.

4 Values from old growth stands.

5 100yr. base (McArdle and Meyer, 1930.)

TABLE III. Average Coverage Values for Associations in the *Tsuga mertensiana* Series.
 "." indicates a coverage of less than .5 percent. "1" indicates a coverage of .5 to 1.5 percent
 Zero values are included in the averages.

	TSME/ PHEN-VADE n=11	TSME/ RHAL-PHEN n=2	TSME/ VAME n=35	TSME/ VAME-VAAL n=14	TSME/ RHAL-VAME n=9	TSME/ DEPA n=12	TSME/ TIUN-STRO n=4	TSME/ VAAL n=43	TSME/ OPHO n=2
<u>TREES</u>									
ABAH	12 (82)	23 (100)	52 (97)	54 (100)	43 (100)	47 (92)	70 (100)	50 (100)	60 (100)
ABLA2	10 (45)	10 (50)	1 (3)	1 (7)	1 (11)	10 (25)			
CHNO	1 (9)		. (9)	4 (16)	3 (22)	2 (42)		2 (14)	13 (50)
TSHE			1 (11)	4 (9)	1 (11)	6 (25)	5 (50)	14 (70)	8 (11)
TSME	39 (100)	30 (100)	36 (91)	33 (100)	45 (100)	43 (100)	17 (100)	32 (98)	10 (100)
<u>SHRUBS AND HERBS</u>									
ARLA	1 (18)		1 (23)	1 (29)	1 (22)		1 (25)	1 (5)	
ATFI			. (17)	. (14)	. (11)		1 (50)	. (19)	9 (100)
BLSP			. (3)	1 (21)	. (11)		1 (25)	1 (63)	
CABI			. (3)	1 (7)				. (12)	
CAME	11 (82)	1 (50)	. (6)	. (7)	. (11)	. (8)		. (5)	
CANI2	1 (27)		. (6)	. (7)	. (11)			. (2)	
CLUN			. (20)	2 (71)	1 (33)	. (17)	2 (75)	4 (81)	4 (100)
COCA		1 (50)		. (7)	. (11)			1 (35)	
ERPE	1 (18)		. (3)						
GYDR			. (14)	1 (21)	2 (22)	. (8)	1 (50)	. (16)	14 (100)
LUHI	1 (18)			. (7)					
LUPE	1 (36)		. (3)	. (7)	. (11)	. (8)			
MADI				. (7)				. (16)	
MEFE	2 (36)	3 (50)	3 (40)	5 (79)	5 (56)	. (33)	2 (75)	3 (74)	3 (100)
OPHO								. (14)	10 (100)
PHEN	23 (91)	16 (100)	1 (26)	. (14)	1 (33)			. (2)	
RHAL	1 (18)	15 (100)	. (20)	1 (21)	24 (100)	1 (17)	1 (25)	1 (16)	
RULA	2 (18)	13 (50)	1 (23)		. (22)	1 (17)	1 (25)	. (16)	
RUPE	1 (9)	5 (100)	6 (74)	9 (100)	9 (56)	1 (75)	30 (100)	9 (98)	13 (100)
RUSP			. (14)	. (21)	2 (33)	. (8)	. (25)	. (30)	15 (100)
SOSI	1 (55)	4 (50)	1 (51)	1 (79)	. (44)	1 (33)	1 (100)	1 (58)	
STRO			1 (31)	1 (43)	1 (44)	. (25)	11 (100)	1 (65)	5 (100)
TIUN			1 (34)	1 (36)	1 (33)	. (33)	16 (100)	. (21)	8 (100)
VAAL		25 (50)	1 (23)	28 (93)	12 (44)	1 (42)	5 (100)	46 (100)	28 (100)
VADE	35 (91)	15 (50)	1 (20)	. (14)	2 (33)	. (17)			
VAME	18 (82)	8 (50)	44 (100)	23 (100)	36 (100)	3 (92)	6 (100)	2 (79)	2 (100)
VAOV			1 (46)	5 (64)	1 (22)	. (17)	3 (75)	8 (60)	1 (50)
VASI	2 (36)	. (50)	2 (46)	3 (36)	1 (33)	. (33)	1 (50)	. (12)	

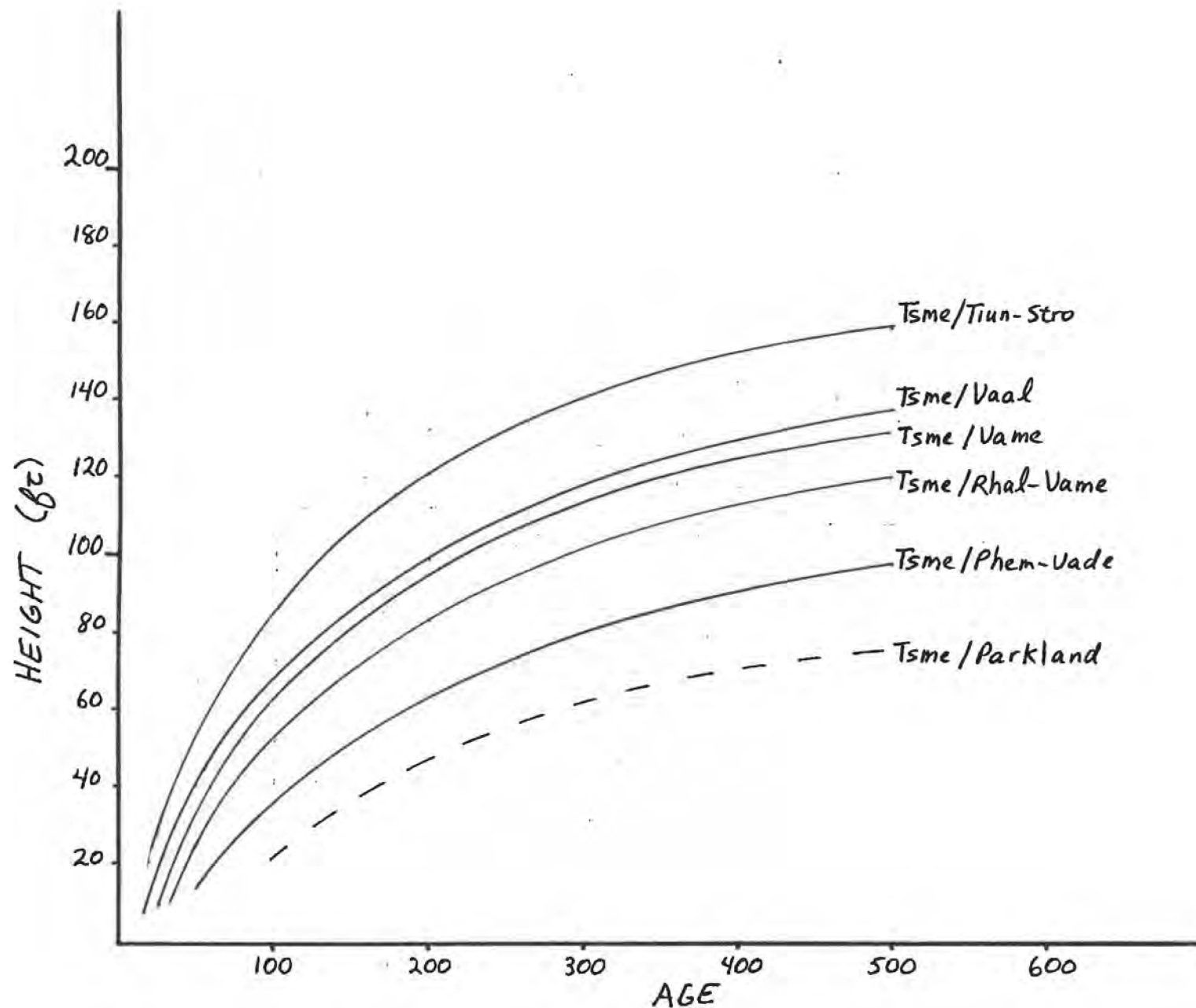


Figure 11. Height Growth Curves for the Common Tsme types

Tsuga mertensiana/Oplopanax horridum (Mountain hemlock/Devil's club, Tsme/Opho) Association

The Tsuga mertensiana/Oplopanax horridum Association is tentatively recognized here on the basis of two plots. It is previously described for the Skykomish and Darrington Districts and may be considered a high elevation variant of the more common Abam/Opho type (Henderson and Peter 1983, 1984). It occurs in wet places in the upper elevational range of the silver fir zone (mean elevation was only 3345 feet (1020 m). The presence of mountain hemlock may signify a frost pocket or some other micro-environmental anomaly, within the Abam/Opho type.

Tsuga mertensiana/Caltha biflora (Mountain hemlock/Marsh marigold, Tsme/Cabi) Association

The Tsuga mertensiana/Caltha biflora Association is a minor type of spotty occurrence. It is represented by only one plot from this area. It was recognized in the Darrington District Report and has been recorded throughout much of the Forest. It rarely occurs over a very large area at a time, as it is fairly specific to wet, seepy and somewhat organic sites. Often there is considerable water at the surface, even on moderate slopes. Its productivity potential is low, although about average for the mountain hemlock zone.

Mountain hemlock, silver fir and Alaska yellow-cedar are the major tree species ground vegetation is often dominated by Caltha, along with Athyrium sp., Carex sp., Mitella breweri, Ribes bracteosum and Arnica latifolia.

Wildlife values may be fairly high for summer foraging elk in certain areas.

Tsuga mertensiana/Tiarella unifoliata - Streptopus roseus (Mountain hemlock/Foamflower-rose twisted stalk, Tsme/Tiun-Stro) Association

The Tsuga mertensiana/Tiarella unifoliata - Streptopus roseus Association was previously recognized only in the Darrington District (Henderson and Peter 1984) for the Cascades of Oregon and Washington. It is represented by four plots from the Mt. Baker District. Several other plots from districts to the south are now assignable to this type.

It typically occurs in coves or swales at lower elevations in the mountain hemlock zone. It also seems to prefer warm aspects. Productivity estimates suggest that this is the most productive of the mountain hemlock types so far recognized for the Forest (Table II). Top heights of old-growth typically exceed 140 feet (43m) with a regression estimated height of dominants of 86 feet (26m) at 100 years.

Silver fir and mountain hemlock are the dominant trees. The ground vegetation is typically without significant shrub cover. Big huckleberry (Vaccinium membranaceum) may be up to 20 percent if Tiarella and Streptopus are over 10 percent cover. This herb rich understory is characterized by Tiarella and Streptopus plus Rubus pedatus, Clintonia uniflora, and on some sites Athyrium filix-femina or Smilacina stellata.

Tsuga mertensiana/Rhododendron albiflorum - Vaccinium membranaceum (Mountain hemlock/White rhododendron - Big huckleberry, Tsme/Rhal-Vame) Association

The Tsuga mertensiana/Rhododendron albiflorum - Vaccinium membranaceum Association occurs sporadically at high elevations, (3165-5900 feet, 965-1798m) and on northerly aspects in the study area. Plots were sampled in the drier areas north of Mt. Baker and in the upper Suiattle River drainage. It is also known from similar sites south of this area. Nine plots were sampled from this area. This makes a total of 31 plots sampled in the Olympic and Mt. Baker-Snoqualmie areas combined. It is known from the Findley Lake area of the Cedar River drainage (Del Moral 1973), from near Bear Head lookout in the Carbon River drainage (Henderson and Peter 1981c), from Mount Rainier National Park (Franklin et al. 1979) from the Shelton District near Mount Tebo (Henderson and Peter 1981a), from one location on the Quinault District from near Colonel Bob (Henderson and Peter 1981b) and from the drier easterly areas of the Darrington District. Although not recognized, this type is represented in the data of Brooke et al. (1970).

Dominant tree heights in old growth stands averaged 92 feet (28 m) (Table II) and only 64 feet (20 m) at 100 years (Figure 9). This compares to 109 feet (33 m) for the same type on the Darrington District 46 feet (14 m) for the White River District and 26 feet (8 m) on the Shelton District. Basal area of old growth stands averaged 29 ft²/ac (718 m²/ha). Productivity potential is low. Maximum old growth volumes estimated from sampled stands are about 7000 ft³/ac with a culmination of MAI at about 200 years and 33 ft²/ac/yr. MAI at 100 years is estimated to be 14 ft³/ac/yr.

Wildlife and other values are not well known. It may provide some hiding and thermal cover for summering deer. It is also important cover on major high elevation watersheds.

Disturbance factors in this type are not well known. Fires from warmer, lower elevation sites can sometimes slop over into this type but fire is not easily carried and often goes out. Snow movement and avalanches can be a factor if originating on higher sites. Communities representing the Tsme/Rhal-Vame Association occur high enough in the mountains to have been affected by at least the last lobe of the little ice age which reached its maximum about 1750. These communities have been developing in response to a subtle warming trend and lower snowpack accumulations for the past couple hundred years. Ages of trees suggest that forest cover was established before this ice age but very few trees were established during and that many trees have become established since. These cold, snowy climates are still a driving force behind the development of this type.

Sampled communities were dominated by mountain hemlock with lesser amounts of silver fir. White rhododendron (Rhal) and big huckleberry (Vame) dominate. The huckleberries (Vaal and Vaov) can also be major species in the community, on certain sites. Herbs are sparse, with Rubus pedatus, Blechnum spicant and Mitella breweri usually present.

Tsuga mertensiana/Rhododendron albiflorum - Phyllodoce empetriformis (Mountain hemlock/White rhododendron - red heather, Tsme/Rhal-Phem) Association

The Tsuga mertensiana/Rhododendron albiflorum - Phyllodoce empetriformis Association is represented by two plots which were sampled on the Mt. Baker District, and ten more which have been sampled to the south. This is a high elevation type (5043 feet, 1537 m) of cool and often gentle aspects (Table II). Top heights of old-growth averaged only 71 feet (22 m) and the site index estimated from regression was 44 feet (13 m) at 100 years.

Total tree cover was low indicating its near-parkland affinities. Mountain hemlock was the dominant tree species followed by silver fir and sub alpine fir (Table III). The shrub rich ground vegetation included Rhododendron albiflorum, Phyllodoce empetriformis, Vaccinium alaskaense, Vaccinium deliciosum, V. membranaceum and Rubus lasiococcus.

This low productivity near-parkland association has its highest values for recreation and esthetics and summer hiding and thermal cover for animals.

Tsuga mertensiana/Phyllodoce empetriformis-Vaccinium deliciosum (Mountain hemlock/Red heather-blueleaf huckleberry, Tsme/Phem-Vade) Association

The Tsuga mertensiana/Phyllodoce empetriformis-Vaccinium deliciosum Association is the common parkland type in the study area. It is considered a "woodland" type according to the new national "RET" classification since in its mature form it averages less than 40% tree cover. Given current climatic conditions it is considered a stable type dominated by widely spaced trees or groups of trees often with little vegetation under the tree clumps and mostly a mosaic of the subalpine heather-huckleberry type between. It occurs above 4600 feet (1402 m) and averaged 5425 feet (1654 m). Aspects are quite variable. Slopes vary from gentle to very steep. Eleven plots were sampled which represent this type, several other heather huckleberry meadow plots were also taken. It is estimated that this type is about 18% of the mountain hemlock zone for this area.

Fire and Wind and Other Long Term Environmental Disturbances

The very sparse evidence of fire in this type indicates only small spot fires started by lightning strikes. It is virtually impossible for fire to be carried very far in this type. We know of no significant windthrow damage in this type. Wind action and the abrasion of wind-carried ice appears to at least partially limiting to this type as it grades into Krummholz in some areas. Wind desiccation in summer may be a significant factor in limiting the growth of trees by maintaining a high level of water stress and retarding the maturation of plant tissues.

The greatest disturbance factor in this type over the last 1000 years or so has been the combined effects of climatic shifts associated with episodes of the "Little Ice Age". Few trees are found which can be dated to the periods of ice advance 1645-1715 a.d. and 1416 to 1534 a.d. Most tree clumps in this type contain trees under 200 years old, a few contain older veterans, 350-450 years and fewer yet contain trees which predate the 1416-1534 ice advance. These trees are mostly about 600 years or older than 700 years.

The dynamics of this type are profoundly affected by the climatic shifts associated with these ice advances. Succession in this type is so slow that, even though there is some evidence that total tree cover is increasing toward canopy closure, there will likely be another little ice age before a significant change occurs.

Species Composition and Succession

The tree clumps which constitute the "overstory" of this type are dominated by mountain hemlock with only minor amounts of silver fir, yellowcedar or subalpine fir.

The meadow-like mosaic between tree clumps is of the typical heather-huckleberry type with red heather (Phem), blueleaf huckleberry (Vade) and White heather (Came) predominating. Big huckleberry (Vame) is sometimes found associated with the tree clumps. Other species sometimes encountered are Cani2, Lupe, Mefe, Sosi, Vasi, and Rula (Table III).

Succession on this type is so long term and complicated by climatic fluctuations that it is very difficult to figure out and describe. Primary succession begins on deglaciated rubble or secondary succession begins with the effects of a warming trend on a heather-huckleberry meadow. Primary successional species such as Phem, Vade, Lupe, Lula or Luzula spp. may dominate early stages.

Timber Productivity

Timber productivity potential is extremely low. Trees which were estimated to be 100 years old were 36 feet (11 m) tall (Figure 11). Basal area for sampled plots averaged 210 ft²/ac (64 m²/ha). This is an overestimate because no plots which fell wholly between tree clumps were included. Based on this overestimate of stocking, culmination was estimated at 11 ft³/ac/yr. Productivity at 100 years was estimated to be 3.5 ft³/ac/yr on the Darrington District.

Wildlife Relations

Little is known about the relationships of this type to wildlife. It probably provides some part of the summer range of black-tail deer and is a major part of the habitat of mountain goats, although their direct use is unknown.

Distribution and Relation to Other Types

This type is strongly related to the non-forest heather-huckleberry type of Mt. Rainier N.P. (Henderson 1974). It is also related to the Tsme/Vame type which occurs at lower elevations and has a more typical closed forest canopy and to the Tsme/Rhal-Phem type which occurs at high elevations but on colder, sites.

This type occurs at least as far south as Mount Rainier, although it was not recognized by Henderson (1974) or Franklin et al. (1979). We did not recognize it in earlier surveys on the Darrington District, and Henderson and Peter (1984) the Snoqualmie and adjacent Skykomish River drainages (Henderson and Peter (1982b). It was recognized in the Olympics by Henderson et al. 1979 and in the upper Middle Fork of the Snoqualmie River by Del Moral et al. (1976). It is recognized by Brooke et al. 1970 for British Columbia. It is a common type in the Cascades north of Snoqualmie Pass and in the Olympics.

Tsuga mertensiana/Vaccinium alaskaense - Vaccinium membranaceum (Mountain hemlock/Alaska huckleberry - Big huckleberry, Tsme/Vaal-Vame) Association

The Tsuga mertensiana/Vaccinium alaskaense - Vaccinium membranaceum Association is intermediate between the moister Tsme/Vaal type at lower elevations and the drier Tsme/Vame type at higher elevations. It is intermediate between these two types in many ways and growth and yield information can be interpreted as well. It was originally considered an intergrade between these two types.

Many of the same species common to the Tsme/Vaal and the Tsme/Vame types are found in this Association. Mountain hemlock and silver fir dominate the tree layers along with an occasional yellowcedar or western hemlock. In the ground vegetation layers Alaska and Big huckleberries dominate other common species include Menziesia ferruginea, Rubus pedatus and Vaccinium ovalifolium (Table III).

Timber productivity potential is low (Table II). Old-growth top heights averaged 116 feet (35 m) and height at 100 years was estimated to be 66 feet (20 m). Old-growth basal area averaged 293 ft²/ac (67 m²/ha).

Wildlife values are relatively unknown. Deer, bear and probably numerous small mammals and birds use the huckleberries for food.

This type was first recognized in the Darrington District (Henderson & Peter 1984), having been considered an intergrade before.

Tsuga mertensiana/Vaccinium membranaceum (Mountain hemlock/Big huckleberry, Tsme/Vame) Association

The Tsuga mertensiana/Vaccinium membranaceum Association occurs on relatively dry-warm habitats in the Tsme zone throughout the area. Sampled locations varied from 4100 ft (1250 m) where it closely resembles the Abam/Vame type to 5700 ft (1737 m) where it begins to grade into Krummholz communities. It occurs mostly on southeast to southwest aspects on moderate to steep or even gentle (but well drained) slopes. It is estimated that this type comprises about 20% of the mountain hemlock zone for this area. It was well represented in the area with 35 plots sampled.

Fire and Wind and Other Long-term Environmental Disturbances

Fires of any extent are uncommon in the mountain hemlock zone. When they occur they are most likely in the Tsme/Vame type or other closely related types. To the south, recent fires on Evergreen Mountain, Cady Ridge, Tonga Ridge and Granite Mountain appear to have burned into this type. Wind disturbance is minor, except on some exposed ridge tops.

Long-term climatic fluctuations are not as important in this type as in the Tsme/Phem-Vade at higher elevations. However, there is some evidence that portions of this type that occur today were, within recent geologic time, more similar to the Tsme/Phem-Vade type. As climates have warmed and vegetation zones have advanced slightly higher in elevation, this replacement has taken place at what would have been the ecotone between these two types.

Species Composition and Succession

Mountain hemlock and silver fir codominate the old-growth communities (Table III). Western hemlock (at lower elevations), yellow-cedar and subalpine fir were also encountered. Noble fir and even Douglas-fir are sometimes found in the driest portion of this type farther south, although they were not sampled in this area.

The ground vegetation layers are dominated by Big huckleberry (Vame) while fool's huckleberry (Mefe) may codominate on some sites. Blueleaf huckleberry (Vade) may be seral and will persist into young old-growth stands at higher elevations. Other huckleberries are uncommon. Mountain ash (Sosi) is encountered with high frequency but low average cover. Common herbs include Rubus lasiococcus, Valeriana sitchensis, Rubus pedatus, Tiarella unifoliata and Streptopus roseus. Beargrass (Xete) is encountered on the dry portion of this type to the south where it identifies the beargrass phase (Tsme/Vame-Xete) (Table III) but was not sampled in this area.

Succession on this type following fire (or clearcutting) is very slow. Brush fields of huckleberries, popular with berry pickers, may persist for 50-150 years before trees reclaim the site. Under the most favorable conditions with some residual seedlings from the previous stand it still appears to take about 20 years to approach normal stocking. Most of the railroad fires from around the turn of the century are still huckleberry fields.

Timber Productivity

Timber productivity potential is low. Mountain hemlock trees averaged 64 feet (20 m) at 100 years (Figure 11). Old growth stands, 300 to 700 years old, averaged 324 ft²/ac (74 m²/ha) of basal area (Table II). There are also many other communities not included in this average, which had no basal area at all. Old-growth volume appears to peak at about 7500 ft³/ac at about 400 years. Culmination of MAI was calculated to occur at 320 years with 35 ft³/ac/year, with full immediate stocking for this type.

Wildlife Relations

Deer and bear use this type in the summer, especially in young and early seral stages. The fruits and foliage provided by big huckleberry may also be important in the summer diet of many other wildlife species. Goat hair is sometimes collected in this type but it is not known how much goats use it.

Distribution and Relation to other Types

The Tsme/Vame Association is found from the central Oregon Cascades where it is included by Dyrness et al. (1974) and by Hemstrom and Emmingham (1981a) in the Abam/Vame/Xete type. It is recognized on the Mt. Hood and Gifford Pinchot National Forests by Hemstrom and Emmingham (1981b, c) as the Abam-Tsme/Vame Association. It was not recognized by Franklin et al. (1979) for Mt. Rainier National Park. However, it is represented in their samples and they have split up this type into segments of the Abam/Rhal, Abam/Mefe and Abam/Rula types.

It was recognized by Henderson and Peter for the White River District (1981 c), and the Darrington District (1984). but not for the Green and Cedar River drainages although it is to be expected there (Henderson and Peter 1981d). Del Moral (1973) may have sampled it in the Findley Lake basin but he did not recognize it there. It was recognized as the Abam/Vame-Vaov community type by Del Moral and Long (1977) for the Cedar River drainage and as the Tsme-Abam/Vame-Mefe community type by Del Moral et al. (1976) in the upper Middle Fork of the Snoqualmie drainage.

In the Olympics it was recognized as the Abam-Tsme/Vame community type by Henderson et al. (1979) and as the Tsme/Vame Association by Henderson and Peter (1981a, b). Brooke et al. (1970) recognized the Vaccinio-Tsugetum mertensianae Association in British Columbia.

It also appears to have close relatives in the northern Rocky Mountains. It is similar to the Tsme/Mefe and Tsme/Xete habitat types of Daubenmire and Daubenmire (1968) in northern Idaho and even to the Aba/Vagl type of Pfister et al. (1977) for Montana.

Tsuga mertensiana/Vaccinium alaskaense (Mountain hemlock/Alaska huckleberry, Tsme/Vaal) Association

The Tsuga mertensiana/Vaccinium alaskaense Association is well represented in the study area, where 19 plots were sampled. It is one of the dominant Tsuga mertensiana types in this area, with several possible phases. It is also represented in most other areas studied. It ranges mostly from 3000 to 4500 feet (914 to 1219 m) with an average elevation of 3661 feet (1372 m). Aspects are varied.

Fire and Wind Disturbance

Little is known of the fire history of the Tsme/Vaal type in this area. It is presumed that, because of the lack of evidence to the contrary that this type seldom burns, and in fact provides a suitable fire break when encountered. Wind disturbance is minor, with some top breakage noted in ridge top positions. Some areas are influenced by avalanches.

Species Composition and Succession

The tree layers of this association are dominated by mountain hemlock and silver fir, plus lesser amounts, on the average of yellowcedar in wetter places and western hemlock at lower elevations Table III. The proportion of silver fir and mountain hemlock changes from more silver fir and a minimum amount of mountain hemlock at lower elevations or drier aspects to a greater dominance by mountain hemlock at higher elevations and colder sites but more typically they codominate the oldest stands and the projected climax community contains both as codominants.

Understory layers are clearly dominated by Alaska huckleberry (Vaal) or ovalleaf huckleberry (Vaov). However, other shrubs including fool's huckleberry (Mefe), may codominate on certain sites. Common herbs include Clintonia uniflora, Cornus canadensis, Rubus pedatus, Streptopus roseus, and Blechnum spicant.

Timber Productivity

Timber productivity potential in this extensive type is low (Table II). Top heights of dominant trees in old-growth communities averaged 123 feet (37 m) and basal area averaged 287 ft²/ac (66 m²/ha). Based on height curves for this type (Figure 11) dominant trees are expected to be 68 feet tall at 100 years of tree growth (much lower after 100 years following disturbance because of the establishment lag for this type). Culmination was estimated to occur at about 220 years when a maximum 37 ft³/ac/yr is attained.

Wildlife Relations

Little is known about the relationship of this type to wildlife. However, it probably provides some part of the summer range for deer and elk (where they are present). Mountain goats are occasionally spotted in this type, but are probably only passing through.

Distribution and Relation to other Types

This type is strongly related to the Abam/Vaal type at lower elevations which is recognized by the absence of mountain hemlock and greater abundance of western hemlock. Relative to the other associations in the Tsme series, this type is considered modal for this area. Tsme/Vame and Tsme/Depauperate are drier, Tsme/Opho, is wetter and Tsme/Rhal-Vame and Tsme/Phem/Vade are colder.

This type is not yet recognized in Oregon, however the plot data of Dyrness et al. (1974) suggests that fragments of it might occur as far south as the H.J. Andrews Experimental Forest. It was not recognized by Franklin et al. (1979). Communities herein recognized as belonging to the Tsme/Vaal association were absorbed into their Chno/Vaov and Abam/Vaal types. This type is recognized as the Abam/Vaov and the Tsme-Abam/Vaal-Mefe community types by Del Moral et al. (1976) for the Middle Fork of the Snoqualmie River. A dry phase, called the Abam-Tsme/Vaal/Xete community type, was recognized in the Hoh drainage in the Olympics (Henderson et al. 1979). The Tsme/Vaal Association was previously recognized on the White River and North Bend Districts Henderson and Peter (1981c, d) on the Darrington District, Henderson and Peter (1984) and on the Shelton and Quinault Districts, Olympic N.F. Henderson and Peter (1981a, b). It was not recognized on the Soleduck District Henderson and Peter (1982a). It is recognized in British Columbia by Brooke et al. (1970).

Phases and Variations

This is an extensive type with some possibilities for further subdivision. A possible phase recognized by the codominance of Mefe or Vaov can occur on colder sites within this type. In other areas the presence of Xete may form the basis for recognition of still another (dry) phase. There are some subtle differences between these "phases" that related to minor environmental differences within this type. There were few significant successional or productivity and no compelling statistical differences, therefore there was more incentive to retain this as one Association at this time than to split it apart.

Tsuga mertensiana/Depauperate (Mountain hemlock/Depauperate, Tsme/Dep.)
Association

The Tsuga mertensiana/Depauperate Association occurs on moderate mid to upper slope positions, on well drained sites. Although it may occur from 4000-6000 feet (1220-1829 m) it usually occurs at the dry edge of the range of the mountain hemlock zone. Sixteen stands were sampled in this type.

Mountain hemlock and silver fir codominate the tree layers. The ground vegetation layers are sparse (Depauperate), typically with only about 5 percent or less total understory cover. In this area Menziesia ferruginea, Vaccinium alaskaense, Vaccinium membranaceum, Rubus pedatus, and Tiarella unfoliata are the most common understory species.

This type is not recognized elsewhere, except in the middle fork of the Snoqualmie River drainage (Henderson and Peter 1982b), and on the Skykomish District. It is a difficult type to define and as presented here is probably represented both by plots representing an actual depauperate type and some which are depauperate conditions of other types due to stand history factors. The person using the key to identify a depauperate plot is urged to consider surrounding vegetation and the physical site parameters. In this way it may be possible to assign the site more accurately to another type.

Abies amabilis

(Silver fir, Abam) Series

The *Abies amabilis* (Abam or silver fir) series represents about 212,000 acres (86,000 ha) or about 42% of the area. A total of 382 plots have been taken in the Abam zone, of which 253 represent old-growth communities.

Eleven Associations are recognized from the data, the Abam/Vame, the Abam/Vaal, Abam/Vaal-Gash, Abam/Vaal-Libo2, Abam/Vaal-Opho, the Abam/Opho, Abam/Tiun, Abam/Pomu, Abam/Bene and Abam/Depauperate. By far the most extensive of these is the Abam/Vaal type, for which several phases can be recognized.

The Abam series occurs on the cooler, mid-elevation slopes and moist stream bottoms. On the slope it occurs from about 1500 feet (350 m) on north aspects to 2300 feet (700 m) on south aspects; up to 3300 feet (900 m) on north aspects to 4300 feet (1067 m) on south aspects. In stream bottoms it occurs down to about 700 feet (213 m). The elevational relationships in this area are more complex than others, as represented in Figure 6 and Figure 7.

The Abam zone is characterized by cooler moist soils, persistent winter snowpack, a general lack of summer plant water stress and a short cool growing season. Mean annual temperature in this zone is between 5-7°C (41-45°F) while the warmer Tshe zone averages 10.1°C (50.2°F) and the colder, snowier Tsme zone ranges from 3-5°F (37-41°F). Precipitation in the Abam zone is over 100 inches (254 cm) annually with much of it coming as snow and persisting on the ground until April at the low elevations and June at high elevations. These climatic factors result in a much longer fire return period and much lower fire risks than the Tshe zone.

Wildlife values in the Abam zone are lower than the Tshe zone which provides most of the deer and elk winter range and the Tsme zone which provides mainly summer range. The Abam zone can provide much of the spring runoff and is therefore important hydrologically because of the delayed discharge. the Abam zone in general provides considerable dispersed recreation activity and is important as an esthetic backdrop to many scenic vistas.

Key to the Associations in the Abies amabilis Series.

1 Big huckleberry (VAME) $\geq 10\%$ cover.....	ABAM/VAME	p. 42
1 Big huckleberry (VAME) $< 10\%$ cover.....(2)		
2 Alaska huckleberry (VAAL) plus ovalleaf huckleberry (VAOV) $\geq 10\%$ cover.....(3)		
3 Devils club (OPHO) $\geq 5\%$ cover.....	ABAM/VAAL-OPHO	p. 45
3 Devils club (OPHO) $< 5\%$ cover.....(4)		
4 Salal (GASH) $\geq 5\%$ cover.....	ABAM/VAAL-GASH	p. 48
4 Salal (GASH) $< 5\%$ cover.....(5)		
5 Twinflower (LIBO2) and oregongrape (BENE) both present and at least one $\geq 5\%$ cover.....	ABAM/VAAL/LIBO2	p. 49
5 Not as above.....(6)		
6 Foamflower (TIUN+TITR) $< 5\%$ cover.....	ABAM/VAAL	p. 46
6 Foamflower (TIUN+TITR) $\geq 5\%$ cover.....(7)		
7 Alaska huckleberry (VAAL+VAOV) $\leq 20\%$ cover.....	ABAM/TIUN	p. 50
7 Alaska huckleberry (VAAL+VAOV) $> 20\%$ cover.....	ABAM/VAAL	p. 46
2 Alaska huckleberry (VAAL+VAOV) $< 10\%$ cover.....(8)		
8 Devils club (OPHO) $\geq 5\%$ cover.....	ABAM/OPHO	p. 43
8 Devils club (OPHO) $< 5\%$ cover.....(9)		
9 Swordfern (POMU) $\geq 5\%$ cover.....	ABAM/POMU	p. 51
9 Swordfern (POMU) $< 5\%$ cover.....(10)		
10 Foamflower (TIUN+TITR) $\geq 5\%$ cover.....	ABAM/TIUN	p. 50
10 Foamflower (TIUN+TITR) $< 5\%$ cover.....(11)		
11 Oregongrape (BENE) $\geq 5\%$ cover.....	ABAM/BENE	p. 52
11 Oregongrape (BENE) $< 5\%$ cover.....(12)		
12 Twinflower (LIBO2) $\geq 10\%$ cover and Alaska huckleberry (VAAL OR VAOV) present.....	ABAM/VAAL/LIBO2	p. 49
12 Not as above.....(13)		
13 Alaska huckleberry (VAAL+VAOV) $\geq 5\%$ cover.....	ABAM/VAAL	p. 46
13 Alaska huckleberry (VAAL+VAOV) $< 5\%$ cover.....(14)		
14 Five-leaved bramble (RUPE) $> 10\%$ cover.....	ABAM/RUPE	p. 44
14 Five-leaved bramble $< 10\%$ cover.....(15)		
15 Understory except vine maple (ACCI) $\leq 10\%$ cover.....	ABAM/Depa	p. 53
15 Understory except vine maple (ACCI) $> 10\%$ cover.....	Rare or undescribed type or seral or disturbed condition	

Table IV. Environmental and Productivity Values for Associations in the *Abies amabilis* Series.

	ABAM/ DEPA n=34	ABAM/ BENE n=5	ABAM/ VAME n=20	ABAM/ VAAL-GASH n=7	ABAM/ VAAL-LIBO2 n=10	ABAM/ VAAL n=117	ABAM/ POMU n=13	ABAM/ TIUN n=22	ABAM/ OPHO-VAAL n=51	ABAM/ OPHO n=21
ELEVATION (ft)	3305±735 ¹	2808±943	4133±695	2849±413	2831±802	3095±638	1666±988	2870±886	2175±789	2306±889
ASPECT (most common)	ALL	SW	SW	SW	SW	ALL	SW,SE	ALL	ALL	ALL
SLOPE(%)	49±20	68±21	33±20	59±19	53±12	42±21	30±25	38±19	37±22	36±23
TOPOGRAPHIC MOISTURE ²	5.1±1.0	4.6±.5	4.8±1.0	4.0±1.4	5.2±.8	5.2±1.1	6.2±1.0	5.9±1.0	6.4±1.1	6.8±.9
SOIL TEMPERATURE ³	9.4±1.8	8.5±2.1	8.7±1.7		9.4±2.0	9.4±1.9	11.5±1.5	11.0±2.4	10.4±2.3	10.8±2.2
TOP HEIGHT ⁴ (ft)	150±36	165±46	131±35	154±45	163±47	157±27	172±26	156±31	167±34	167±29
BASAL AREA ⁴ (ft ³ /ac)	334±82	348±120	353±103	338±96	341±64	320±79	378±93	293±62	272±87	255±100
SITE INDEX ⁵	113	125	94	114	128	119	140	127	131	132

1 Values are ± one standard deviation.

2 Relative scale with 1=no water holding capacity and 9=aquatic. Reflects topographic redistribution of groundwater.

3 Mean soil temperature at 8" (20 cm.) in centigrade measured during the summer months.

4 Values from old growth stands.

5 100 yr. base (McArdle and Meyer, 1930.)

TABLE V. Average Coverage Values for Associations in the *Abies amabilis* Series.
 "." indicates a coverage less than .5 percent. "1" indicates a coverage of .5 to 1.5 percent.
 Zero values are included in the averages.

	ABAM/ DEPA n=47	ABAM/ BENE n=5	ABAM/ VAME n=20	ABAM/ VAAL-GASH n=7	ABAM/ VAAL-LIBO2 n=10	ABAM/ VAAL n=117	ABAM/ POMU n=13	ABAM/ TIUN n=22	ABAM/ OPHO-VAAL n=51	ABAM/ OPHO n=21
TREES										
ABAM	54(100)	25(100)	61(100)	29(100)	31(100)	57(100)	29(100)	56(100)	43(100)	44(100)
CHNO	1 (9)	2 (20)				1 (3)				
PIMO	. (1)		2 (25)			. (1)				
PSME	7 (29)	15 (80)	11 (50)	13 (83)	12 (83)	2 (13)	6 (17)		2 (8)	
TABR	2 (21)	10 (80)		1 (33)	12 (67)	. (7)	6 (67)	. (8)	. (8)	2 (20)
THPL	5 (47)	21(100)	6 (50)	26(100)	18(100)	6 (36)	11 (67)	1 (25)	5 (33)	5 (33)
TSHE	56(100)	48(100)	11 (75)	56(100)	58(100)	50(100)	62(100)	44 (92)	53(100)	52(100)
TSME	. (3)		2 (50)			. (15)			. (5)	1 (7)
SHRUBS AND HERBS										
ACCI	. (9)	1 (40)		1 (17)		1 (9)	15 (67)	5 (17)	10 (49)	12 (33)
ATFI	. (9)	1 (40)	1 (25)			1 (37)	3 (83)	4 (92)	7 (90)	6(100)
BENE	. (29)	9(100)	1 (25)	3 (50)	4(100)	. (9)	2 (67)	. (8)	. (3)	1 (7)
BLSP	1 (29)	1 (60)		1 (50)	1 (50)	2 (61)	8(100)	5 (92)	6 (82)	5 (67)
CHME	. (41)	. (40)	2 (50)	1 (50)	1 (50)	. (21)	1 (50)	. (8)	. (3)	
CHUM	. (18)	1 (80)		1 (50)	3 (67)	. (7)	. (17)	. (8)		
CLUN	. (44)	. (20)	1 (50)	1 (50)	1 (67)	2 (73)	1 (33)	1 (92)	2 (92)	2 (73)
COCA	. (41)	1 (80)	. (25)	2 (50)	2 (83)	2 (60)	1 (67)	1 (50)	3 (92)	1 (53)
DRAU2	. (3)					. (23)	2 (83)	4 (42)	2 (49)	1 (47)
GASH	. (3)	. (40)		27(100)	1 (33)	. (2)				
GOOB	. (21)	. (40)	. (25)	. (33)	1 (50)	. (21)	. (17)	. (8)	. (8)	. (7)
GYDR	. (15)	. (40)	1 (25)			1 (28)	2 (67)	3 (75)	3 (79)	6 (93)
LIBO2	. (24)	1(100)	1 (25)	1 (67)	7(100)	. (18)	1 (33)	. (8)	. (8)	. (7)
MADI	. (3)					1 (17)	. (17)	1 (42)	2 (51)	1 (33)
MEFE	. (9)		1 (25)	2 (67)		1 (36)	1 (50)	. (8)	1 (28)	. (13)
OPHO	. (15)	. (20)			. (17)	1 (40)	2 (83)	3 (92)	15(100)	16(100)
POMU	. (18)	1 (60)		. (17)	. (17)	. (15)	28(100)	1 (58)	5 (56)	16 (60)
PYSE	1 (44)	1 (60)	1 (75)	. (17)	1 (50)	. (32)	. (17)	. (25)	. (5)	. (20)
RULA	. (12)	. (20)	. (25)	. (17)	1 (33)	. (8)		. (8)		
RUPE	. (38)	. (40)	10 (50)	. (17)	1 (83)	8 (85)	1 (67)	6 (92)	4 (95)	2 (67)
RUSP	. (12)	. (20)	1 (25)		. (17)	1 (35)	2 (83)	15 (83)	12 (87)	17 (93)
SMST	. (18)	. (20)			. (17)	. (13)	1 (17)	. (25)	2 (41)	1 (47)
SOSI	. (9)		. (25)	. (33)		. (18)	. (17)	. (8)	. (8)	
STRO	. (18)		. (25)		. (17)	1 (40)	. (17)	1 (75)	1 (67)	2 (73)
STST	. (18)		1 (25)			. (25)	. (33)	1 (58)	. (13)	. (27)
TIUN	. (3)					. (8)	. (17)	. (8)	. (21)	. (13)
TIUN	1 (35)	. (40)	1 (25)		1 (33)	2 (49)	5(100)	20(100)	9 (95)	10(100)
VAAL	2 (74)	1 (80)	13 (50)	25(100)	11(100)	34 (99)	3(100)	6 (92)	25(100)	2 (87)
VAME	1 (38)	. (20)	31(100)	1 (33)	. (33)	1 (26)		. (8)	. (5)	. (7)
VAOV	. (6)			6 (33)	. (17)	3 (40)		. (8)	2 (31)	1 (27)
VAPA	. (26)	3 (80)	. (25)	7(100)	2 (50)	1 (31)	1 (67)	. (33)	1 (33)	1 (40)

Abies amabilis/Vaccinium membranaceum (Silver fir/Big huckleberry, Abam/Vame) Association

The Abies amabilis/Vaccinium membranaceum Association is represented by 20 plots in this area. It is found primarily in ecological zones 8, 9 and 10 throughout its range. This corresponds to the precipitation zones with less than 120 inches (318 cm). In the study area it occurred between 3000 and 4900 feet (914-1493 m) elevation on southerly and westerly aspects. Microsite positions and soils are usually well drained.

Fire and Wind Disturbance

Owing to the relatively dry conditions in this type, fires are more common than in other Abam Associations. Too few stands are sampled in this type to say much more about the fire history. Some of the railroad fires to the south from around the turn of the century (e.g. Granite Mountain, Steven's Pass) plus other burns of about the same time have burned in this type. Much of the Tonga Ridge burn below the Tsme zone is in this type.

Species Composition and Succession

The tree layers are dominated by silver fir with 61% average cover and western hemlock and Douglas fir with 11% average cover in old-growth communities. Western redcedar was encountered with an average cover of 6%. Mt. hemlock and white pine were also encountered.

Ground vegetation is dominated by big huckleberry (Vame) which averaged 31% cover in sampled plots. Other common species include Clintonia uniflora, Vaccinium alaskaense, Rubus pedatus, Chimophila menziesii, and Pyrola secunda.

Timber Productivity

Timber productivity potential is generally low to moderate. Douglas-fir and noble fir can grow on this type to the south. Dominant tree heights were estimated to be 94 feet (29 m) at 100 years (McArdle & Meyer, 1930). There was 353 ft²/ac (81m²/ha) in old-growth stands. Yield capability at 100 years (the approximate time of culmination of MAI) is estimated to be about 60 ft³/ac/yr for the type as a whole. The long natural lag in regeneration on this type can significantly reduce productivity. Regeneration is often a problem on this type. Cold soils combined with hot soil surface temperatures and the desiccation of south slopes puts great environmental demands on young seedlings and germinants.

Wildlife Relations

The Abam/Vame type, especially young successional stages, is important summer range for many species of wildlife, including deer and bear. The fruits of the big huckleberry provide a valuable food source for many animals.

Abies amabilis/Oplopanax horridum (Silver fir/Devil's club, Abam/Opho)
Association.

The Abies amabilis/Oplopanax horridum Association occurs infrequently and sporadically throughout the Forest. It is a type of wet places, generally along stream bottoms or in wet seeps on slopes. Twenty-one plots were sampled in this type. Average elevation is 2306 feet; aspects were varied and slopes averaged 36 percent. This type is typically well protected from all but the most severe fire. Wind too may not play much of a role here because of the topographic positions where it tends to occur.

Species Composition and Succession

Analysis of nine old-growth plots in this type shows that western hemlock and silver fir are the dominant tree species, averaging 52 and 44 percent total crown cover. Western redcedar occurred on one third of the plots, and could be considered a minor component (Table V). The dominant shrub is Oplopanax horridum. Rubus spectabilis, Vaccinium alaskaense and Acer circinatum may also occur. Often there is a rich herb layer under the Devil's club. This includes Tiarella trifoliata and T. unifoliata, Athyrium filix-femina, Blechnum spicant, Rubus pedatus, Gymnocarpium dryopteris and Polysticum munitum.

Timber Productivity

Timber productivity relations are poorly understood because of the small sample and patchy nature of this type, occurring mainly along streams. Site index of these stands averaged 132 feet at 100 years (McArdle & Meyer, 1930) and the basal area averaged 255 ft²/ac. (Table IV).

Wildlife Relationships

This type supports many preferred browse, species, especially for elk which apparently do not inhabit the area. Utilization, however, is unclear, but it is probably low because of the inaccessibility of this type. Its overall value for big game in this area is probably low although the potential, especially for elk summer range is high. The value for many non-game species is high, as it provides food, water, and protection. It also often contains significant snags.

Relation to Other Types

This type has been described from Mt. Rainier National Park by Franklin et al. (1979) where it was classified as two phases - the valley or stream bottom phase and the slope phase. They sampled 35 plots in this type, and noted that it is an important type in the Park. Henderson et al. (1979) did not recognize this type in either the Hoh or Dosewallips drainages; however, they did recognize a shrub type with limited tree cover, but dominated by Oplopanax horridum.

Henderson and Peter (1981d) recognized the Abam/Opho type from the Cedar River drainage in the Washington Cascades. Dyrness et al. (1974) recognized a similar Chamaecyparis nootkatensis/Oplopanax horridum type in central Oregon Cascades. Henderson and Peter (1982) recognize the Abam/Opho type based on four plots on the Soleduck District, Olympic National Forest (1982b) and recognize this type to the south in the Snoqualmie River drainages and on the Skykomish (1983b) and Darrington Districts (1984).

Distribution and Relation to Other Types

The Abam/Vame Association is common in the drier areas in the Olympic and Cascade Mountains, usually on south slopes, ridge tops or other dry microtopographic positions.

It is recognized in various forms from Central Oregon Cascades (Dryness et al 1974), (Hemstrom and Emmingham 1981a), to Mount Rainier (Franklin et al. 1979) to the Olympics (Henderson et al. 1979), (Henderson and Peter 1981a) to British Columbia (Brooke et al. 1970). It was recognized by Henderson and Peter (1981c) as a common type on the White River District. It was recognized for the Upper Middle Fork Snoqualmie River as Abam/Vame/Clun by Del Moral et al. (1976). Several other papers refer to this type, also.

Abies amabilis/Rubus pedatus (Silver fir/five-leaved bramble,
ABAM/RUPE) Association=

The *Abies amabilis*/Rubus pedatus association is recognized here on the basis of nine plots for the first time. It was previously considered of phase of the ABAM/VAAL association.

The nine plots averaged 4055 feet (1236m) elevation on mostly northerly aspects of an average of 37% slope. The topographic moisture averaged 6.1 - wetter than ABAM/VAAL.

Productivity indicators suggest that it is similar to the ABAM/VAAL type or about average for the silver fir zone.

The tree layers are dominated by western hemlock and silver fir. Ground vegetation includes relatively small amounts of *Vaccinium Alaskanense*, *tiarella unifoliata*, and *Streptopus roseus* with an average of 31% *Rubus pedatus*.

Abies amabilis/Vaccinium alaskaense - Oplopanax horridum (Silver fir/Alaska huckleberry - Devils club, Abam/Vaal-Opho) Association

The Abies amabilis/Vaccinium alaskaense - Oplopanax horridum Association was recognized by Henderson & Peter (1984) on the Darrington District. It was previously considered an intergrade between the extensive and diverse Abam/Vaal type and the Abam/Opho type of wet slopes and stream bottoms. It is to the wet end of Abam/Vaal and to the dry end of Abam/Opho but is too extensive in this area to relegate merely to inter-grade or phase status.

Fifty-one plots sampled in this type averaged 2175 feet (663 m) elevation. These were generally moderate slopes on warm aspects. However, there is ample topographic moisture on these sites (Table IV.)

Productivity indicators suggest that this type is about the same as the average for the Abam/Vaal type which is also about average for the silver fir zone as a whole.

The tree layers are dominated by western hemlock and silver fir with minor amounts of western redcedar. Ground vegetation includes Alaska huckleberry and devils club along with Athyrium filix-femina, Blechnum spicant, Clintonia uniflora, Cornus canadensis, Rubus pedatus, R. spectabilis, Tiarella unifoliata, and Polystichum munitum.

This type probably occurs as far south as Mt. Rainier in the Cascades.

Abies amabilis/Vaccinium alaskaense (Silver fir/Alaska huckleberry, Abam/Vaal) Association

The Abies amabilis/Vaccinium alaskaense Association is common in this area where it is represented by 117 plots and throughout the Mt. Baker-Snoqualmie Forest. It is found generally above 2400 feet, except in stream bottoms where it may be lower. Average slope was 42 percent; however, slopes over 60 percent are not uncommon. Aspects are variable. The Tsme/Vaal type replaces this type on northerly aspects and at higher elevations. This Association occurs on numerous different soil types (Snyder and Wade 1972). Average elevation (Table IV) was 3095 feet with a range from 565 feet near Baker Lake to 4240 feet near Grouse Butte. Most elevations, however, were between 2300 and 3700 feet. Precipitation is generally over 100 inches, coming mainly as snow or cold rain during the winter. A snowpack accumulates typically from about -3 feet on the warmer sites to 5 or 10 feet at higher elevations or cooler sites. A persistent winter snowpack is a major characteristic of this type, which persists usually until May or early June.

Fire and Wind Disturbance

Fires are very rare in this type. Many hundreds of years elapse between natural wildfires. The fire return period calculated for the Shelton District, Olympic National Forest, was 750 years. Too little data are available for the Mt. Baker District yet to make this calculation; however, it is expected to be between 500 and 1500 years. This is why there are so few stands in the 50-200 year age class. Wind is not a major long-term perturbation.

Species Composition and Succession

Western hemlock and silver fir codominate the canopies of old-growth stands in this type averaging 50 and 57 percent. This is typical of this type throughout its range. Neither hemlock nor fir appear to have a competitive advantage considering total cover for the species in the community. Thus, they are considered co-climax species. Basal area of these two dominant species shows a somewhat different pattern, with silver fir declining with increasing age, while hemlock shows some tendency to increase. The increase in silver fir cover and decrease in basal areas shows a shift toward smaller size classes in older stands. Within this relatively broad type, hemlock predominates more in drier and lower elevation stands, while silver fir has the advantage in moister and higher elevation stands. Douglas-fir may occur in some drier sites in this type and is more common in older stands (500-700 years).

Vaccinium alaskaense is the clear dominant of the ground vegetation averaging 34 percent canopy cover (Table V). Vaccinium ovalifolium is sometimes present in larger amounts than V. alaskaense.

Important herbs include: Blechnum spicant, Rubus pedatus, Clintonia uniflora, and Cornus canadensis, and tiarella unifoliata.

Timber Productivity

Timber productivity is moderate. McArdle and Meyer (1930) site index (applied to all species) averaged 119 while the mean basal area in old-growth plots was 320 ft.²/acre. (Top height of dominant trees was calculated to be 121 feet at 100 years. Basal area at 100 years was similarly estimated to be 225 ft.²/ac.).

Maximum volume accumulation appears to occur about 400 years for this type in this area. This maximum volume from averaged plot data was about 13,000 ft.³/ac. It is interesting to note that total cover of tree species increases beyond 400 years but volume does not.

Douglas-fir shows good height growth potential in the few stands where it occurred. However, when this type is considered over its entire range, Douglas-fir is found naturally only in limited amounts and then mostly on the drier phases of this type. Both western hemlock and noble fir show better growth potential overall than Douglas-fir on this type. Western hemlock is, therefore, our choice as the best single tree species for the Abam/Vaal h.t. in the Cascades. However, a mixture of hemlock and silver fir is probably most feasible. Suitable seed source of Douglas-fir and noble fir, if available, should only be considered on the drier phases of these types. The drier phases are indicated by plants such as Berberis nervosa, Linnaea borealis, Gaultheria shallon, and Vaccinium parvifolium.

Wildlife Relationships

The Abam/Vaal h.t. provides some summer range for deer but very little winter range. Thermal cover is perhaps its main value during summer months. A limited food resource is available from the huckleberries and the succulent herbs. In the Olympics palatability of Vaccinium alaskaense is rated "good" for Roosevelt elk by Schwartz (1939) and is noted to be of "great" importance in their diet. However, stomach analyses have consistently failed to distinguish between Vacciniums. I feel that probably much of what is identified as "Vaccinium" is V. parvifolium, the red huckleberry, which is nearly universally browsed at least by deer throughout the Forest. Vaccinium alaskaense, however, shows limited browsing. For black-tailed deer (Brown 1961) found that red huckleberry was a major browse species, especially in April and May but V. alaskaense was not mentioned in direct browsing observations. This type therefore, is not believed to provide significant browse for either deer or elk. However, some of the herbs such as Blechnum spicant, Tiarella trifoliata and Rubus ursinus are commonly eaten by elk (Schwartz 1939) and perhaps deer as well.

Relation to Other Types

The Abam/Vaal Association is one of the most common in western Washington. Nearly all studies of middle elevation forests have recognized this as a major type in their area. It occurs from Central Oregon (Hemstrom 1981) where it is restricted to a few moist stream bottoms throughout the middle elevations of the Cascades and Olympics in Washington and on into British Columbia. It was recognized by Brockway et al. (1983) as a common type of the Gifford Pinchot N.F., however their data suggest that the wet site phases (Associations?) are missing in their area.

Abies amabilis/Vaccinium alaskaense - Gaultheria Shallon (Silver fir/Alaska huckleberry - Salal, ABAM/VAAL-GASH) Association.

The Abies amabilis/Vaccinium alaskaense - Gaultheria Shallon Association is recognized on the Mt. Baker District on the basis of seven plots. It has not been recognized previously as it was considered to be an integrade between Abies amabilis/Vaccinium alaskaense and Abies amabilis Gaultheria shallon. It tends to be found on warmer and drier sites than Abies amabilis/Vaccinium alaskaense but not so much so as Abies amabilis - Gaultheria shallon. The seven plots averaged 2849 feet in elevation on 59% slopes facing mostly southwest. The presence of significant amounts of salal probably indicates much less of a snowpack than is normally found in Abies amabilis/Vaccinium alaskaense.

Productivity on these sites tends to be moderate to low with Mcardle and Meyer site index (base 100) 114. The mean basal area was 338 sq. ft./acre which is about normal for the ABAM type.

The tree layer is dominated by western hemlock (56% cover), silver fir (29% cover) and western red cedar (26% cover). Douglas fir averaged a significant 13% cover. The understory is strongly dominated by nearly equal amounts of Gaultheria shallon (27% cover) and Vaccinium alaskaense (25% cover). Other shrubs commonly encountered are Vaccinium parvifolius, Vaccinium ovalifolium, and Berberis nervosa. The herb layer is sparse but is often represented by Cornus canadensis, Blechnum spicant, Clintonia uniflora, and Chimaphila menziesii and unbellata.

Vaccinium parvifolium is a favored browse species for deer. The berries of salal and the Vacciniums are probably important to birds and some mammals including bear. Other than these, wildlife values are probably low especially since this is not a widespread type.

Abies amabilis/Vaccinium alaskaense/Linnaea borealis (Silver fir/Alaska huckleberry/twinflower, ABAM/VAAL/LIBO2) Association.

The Abies amabilis/Vaccinium alaskaense/Linnaea borealis association is recognized on the Mt. Baker District on the basis of ten plots. Vegetation to the south on the Mt. Baker-Snoqualmie National Forest and on the Olympic National Forest fitting this description was previously considered a warm/dry phase of the Abies amabilis/Vaccinium alaskaense association. This type has affinities to several other Abies amabilis types other than Abies amabilis/Vaccinium alaskaense. In its upper elevational range it grades towards Abies amabilis/Berberis nervosa and throughout its range it often is somewhat depauperate. The ten plots on the Mt. Baker District averaged 2831 feet in elevation on 53% S.W. aspects (Table IV).

Productivity on these sites is moderate for the Abies amabilis zone. The McArdle and Meyer site index (base 100) was 128 and the basal area averaged 341 sq. ft./acre.

The tree layer is dominated by western hemlock (58% cover) and Abies amabilis (31% cover). Western red cedar and Douglas fir were also present in significant quantities (Table V).

The shrub layer is dominated by Vaccinium alaskaense, with lesser amounts of Berberis nervosa and Vaccinium parvifolium. In the herb layer, besides Linnaea borealis, there are lesser amounts of Chimaphilla umbellata and Cornus canadensis. A shrub that is often found on this type and rarely on others is Pachystima myrsenities. It is especially common in young stands but is also found in older stands. Vaccinium membranaceum is consistently in the higher elevation stands in small quantities but never lower down.

Abies amabilis/Tiarella unifoliata (Silver fir/Foamflower, Abam/Tiun)
Association

The Abies amabilis/Tiarella unifoliata Association occurs infrequently and sporadically throughout the Forest, but it apparently avoids the high precipitation areas (i.e., Environmental Zones 3-7). It occurs in mesic topographic positions, often in draws and coves. Communities in this type are often small and patchy. Average elevation of sampled stands was 2870 feet (875 m) and average slope was 60%.

Productivity indicators suggest this is an average type for the silver fir zone in this area. However, plots to the south indicate that it is among the highest productivity for silver fir types.

The tree layers are dominated by western hemlock and silver fir (Table V), with minor amounts of western redcedar. The herb rich ground vegetation is characterized by Tiarella spp. and Streptopus roseus, plus Athyrium filix-femina, Blechnum spicant, Oplopanax horridum, Rubus pedatus, R. spectabilis, and Vaccinium alaskaense. This type has high similarity to the Abam/Madi type of the Darrington District except that Maianthemum dilatatum is almost absent. However, Abam/Madi is a wetter type of higher precipitation areas.

The herb-rich understory might provide important forage during the summer but little evidence was found.

Abies amabilis/Polystichum munitum (Silver fir/Swordfern, Abam/Pomu)
Association

The Abies amabilis/Polystichum munitum Association is a minor type in western Washington. It is recognized on the Mt. Baker District on the basis of thirteen plots. These two plots show close affinities to Abam/Tiun. The Abam/Pomu type occurs at the lower edge of the silver fir zone in topographically moist areas or in areas where the lower boundary of the silver fir zone is depressed by high precipitation and/or summer fog, as on the Quinault District, Olympic National Forest (Henderson and Peter 1980b).

Productivity indicators are high for the silver fir zone suggesting its close affinity to the Tshe/Pomu type. The McArdle & Meyer site index applied to all species at 100 years is 140. The basal area averaged 379 sq. ft./acre.

The tree layers are dominated by western hemlock with an average cover of 62% and silver fir with an average cover of 29%. Douglas-fir and western redcedar were present in significant amounts. The sparse ground vegetation was characterized by swordfern, plus Blechnum spicant, Gymnocarpium dryopteris, Tiarella unifoliata and Acer circinatum.

Abies amabilis/Berberis nervosa (Silver fir/Oregongrape, Abam/Bene)
Association

The Abies amabilis/Berberis nervosa Association occurs on dry microsites in dry environmental zones (i.e., 9 & 10) throughout the Forest. It is more common to the south especially south of Snoqualmie Pass highway. (Henderson and Peter 1980c,d). It is recognized on the Mt. Baker District based on five plots. Average elevation was 2808 feet (856 m). Productivity indicators are relatively high (Table IV) owing to the presence of Douglas-fir. Douglas-fir is found on this type in small quantities throughout its range.

The tree layers are dominated by silver fir with an average of 25% cover, western hemlock with an average of 48% and western red cedar with 21% cover. Douglas-fir was also present on all but one plot. The ground vegetation is sparse and is characterized by such dry site species as Berberis nervosa, Vaccinium parvifolium, Chimaphila umbellata, Linnaea borealis and Cornus canadensis. This type is closely related to much of the Abam/Depauperate type and under some conditions may not be readily distinguishable.

Abies amabilis/Depauperate (Silver fir/Depauperate, Abam/Dep.) Association

The Abies amabilis/Depauperate Association is a somewhat artificial type which is common throughout much of the Forest. It appears to develop most often on dry microsites, particularly on ridge tops in drier environmental zones. It shows floristic affinities to most Abam types, suggesting that there may be further need for subdividing this type. It might, in fact, be best considered as a phase of several of these types. Most of the communities in this type would in that case be part of the dry Abam/Bene type. This type, in many ways, appears to be a grouping of sites which represent unfilled niches; areas, which by a quirk of nature, fall outside the range of the dominant species; areas which fall between the proverbial "cracks".

The average elevation of plots sampled in this type was 3305 feet (1007 m). Slopes were moderate (49%) and aspects various. Productivity indicators indicate a moderate to low potential for this type. The average basal area was 334 square feet/acre. The average site index was 113 (McArdle & Meyer 1930).

Tree layers are dominated by western hemlock with 63% cover and silver fir with 54% cover. Douglas-fir, Western redcedar, and Alaska yellowcedar may also occur. The ground vegetation is sparse (i.e. depauperate) but characterized by such species as Berberis nervosa, Chimaphila menziesii, Pyrola secunda, Vaccinium membranaceum, Linnaea borealis, Cornus canadensis and Vaccinium parvifolium on drier sites and Blechnum spicant, Clintonia uniflora, Rubus pedatus, Tiarella unifoliata and Vaccinium alaskaense on moister sites.

This type is recognized throughout the Olympic and Mt. Baker-Snoqualmie Forests but not elsewhere.

Tsuga heterophylla (Western hemlock, Tshe) Series

The Tsuga heterophylla Series represents about 93,000 acres (38,000ha) or about 18% of the study area (Figure 8). It occurs primarily along the lower reaches of the major drainages.

The western hemlock zone is generally characterized by less than 100 inches (254 cm) of precipitation most of which comes as rain. The summer drought, typical of Western Washington is well expressed in the Tshe zone. There is little snow accumulation during the winter and when spring arrives, soils begin to warm and plants begin to grow early in the year, in contrast to higher zones which are still under snow.

Of the major ecological variables that affect plant distribution and growth (i.e. moisture, temperature, nutrients and light) the pattern of moisture distribution through the ecosystem and through the seasons appears to correlate best with the pattern of community distribution and tree growth. Sites that have the least amount of available water during the spring and summer are typically the poorest sites for tree growth. These sites throughout the Forest are Salal or Oregongrape types. Wild rose and red huckleberry are often found associated with these types. At the wet extreme where there is impeded water drainage productivity can also be low. The best sites have moderate precipitation, ample soil water holding capacity or a subsurface water supply. At higher elevations in the silver fir and mountain hemlock zones where precipitation increases and a lingering snowpack provides water later into the summer, thereby shortening the drought season, temperature appears to play an increasingly important role.

Regeneration is not often a problem in the Tshe zone. Sometimes some drier sites can pose difficulties where seedlings succumb to summer drought. More often the problem is too much regeneration (combination of planted and naturals or a good catch of naturals) or competition from undesirable species such as red alder or salmonberry. Overstocking is most often a problem on drier sites (salal etc.) on gentle slopes. Brush competition is more often a problem on the moist types such as Tshe/Pomu and Tshe/Vaal.

Soils are variable, mostly derived from granite or metamorphic material, or are glacial deposits of mixed geological composition.

Timber productivity is moderately good, especially on the moist types, such as Tshe/Pomu, certain parts of Tshe/Opho, and Tshe/Vaal. Some extremely high volumes and productivity rates are encountered along some of the well watered toe slopes. On the average, trees (Douglas-fir or western hemlock) can be expected to be about 149 feet at 100 years with an average basal area of 290 ft²/ac. Volumes should average about 15,000 ft³/ac. at culmination of MAI.

Douglas fir is the preferred timber species in the western hemlock zone. Western hemlock, western redcedar and red alder can also be grown with the appropriate silvicultural technique (Table I).

Eleven Tshe Associations are recognized at this time based on 266 total plots but only 98 old-growth plots. These are western hemlock/Devil's club (Tshe/Opho), western hemlock/salal (Tshe/Gash), western hemlock/Alaska huckleberry (Tshe/Vaal), western hemlock/swordfern (Tshe/Pomu), western hemlock/Swordfern-Salal (Tshe/Pomu-Gash), western hemlock/Oregongrape (Tshe/Bene), western hemlock/skunk cabbage (Tshe/Lyam), western hemlock/swordfern-tiarella (Tshe/Pomu-Titr), western hemlock/swordfern-Oregon grape (Tshe/Pomu-Bene), western hemlock/tiarella-oak fern (Tshe/Titr-Gydr) and the western hemlock/Depauperate (Tshe/Dep.) Associations. Of these the Tshe/Pomu is the most common, representing about 40% of the zone in this area. This type is quite productive and most of it has already been cut over. Therefore, most of the communities in the Tshe/Pomu Association are seral second growth stands.

Key to the Associations in the Tsuga heterophylla Series.

1 Skunk cabbage (LYAM) $\geq 5\%$ cover.....	TSHE/LYAM	p. 71
1 Skunk cabbage (LYAM) $< 5\%$ cover.....(2)		
2 Devils club (OPHO) $\geq 5\%$ cover.....	TSHE/OPHO	p. 59
2 Devils club (OPHO) $< 5\%$ cover.....(3)		
3 Alaska huckleberry (VAAL+VAOV) $\geq 10\%$ cover.....	TSHE/VAAL	p. 63
3 Alaska huckleberry (VAAL+VAOV) $< 10\%$ cover.....(4)		
4 Swordfern (POMU) $\geq 10\%$ cover.....(5)		
5 Foamflower (TITR+TIUN) $\geq 5\%$ cover.....	TSHE/POMU-TITR	p. 69
5 Foamflower (TITR+TIUN) $< 5\%$ cover.....(6)		
6 Salal (GASH) $\geq 10\%$ cover.....	TSHE/POMU-GASH	p. 62
6 Salal (GASH) $< 10\%$ cover.....(7)		
7 Oregongrape (BENE) $\geq 5\%$ cover.....	TSHE/POMU-BENE	p. 70
7 Oregongrape (BENE) $< 5\%$ cover.....	TSHE/POMU	p. 64
4 Swordfern (POMU) $< 10\%$ cover.....(8)		
8 Salal (GASH) $\geq 10\%$ cover.....(9)		
9 Swordfern (POMU) $\geq 3\%$ cover.....	TSHE/POMU-GASH	p. 62
9 Swordfern (POMU) $< 3\%$ cover.....	TSHE/GASH	p. 60
8 Salal (GASH) $< 10\%$ cover.....(10)		
10 Alaska huckleberry (VAAL+VAOV) $\geq 5\%$ cover.....	TSHE/VAAL	p. 63
10 Alaska huckleberry (VAAL+VAOV) $< 5\%$ cover.....(11)		
11 Oregongrape (BENE) $\geq 5\%$ cover.....(12)		
12 Swordfern (POMU) $\geq 3\%$ cover.....	TSHE/POMU-BENE	p. 70
12 Swordfern (POMU) $< 3\%$ cover.....	TSHE/BENE	p. 66
11 Oregongrape (BENE) $< 5\%$ cover.....(13)		
13 Foamflower (TITR+TIUN) and oakfern (GYDR) each $\geq 2\%$ cover.....	TSHE/TITR-GYDR	p. 68
13 Foamflower (TITR+TIUN) or oakfern (GYDR) $< 2\%$ cover.....(14)		
14 Understory (shrubs and herbs) except vine maple (ACCI) $\leq 10\%$ cover.....(15)		
15 Vine maple (ACCI) $\geq 10\%$ cover.....(16)		
16 Oregongrape (BENE) present.....	TSHE/BENE	p. 66
16 Oregongrape (BENE) absent.....	TSHE/Depa	p. 67
15 Vine maple (ACCI) $\leq 10\%$	TSHE/Depa	p. 67
14 Understory (shrubs and herbs) except vine maple (ACCI) $> 10\%$ cover.....	Rare or undescribed type or seral or disturbed condition.	

Table VI. Environmental and Productivity Values for Associations in the *Tsuga heterophylla* Series

	TSHE/ GASH n=38	TSHE/ BENE n=24	TSHE/ DEPA n=30	TSHE/ POMU-BENE n=25	TSHE/ POMU-GASH n=26	TSHE/ VAAL n=18	TSHE/ POMU n=53	TSHE/ POMU-TITR n=26	TSHE/ TITR-GYDR n=2	TSHE/ OPHO n=18
ELEVATION (ft)	2025±699 ¹	2429±900	2317±724	1755±626	1329±504	2079±733	1382±1228	1686±643	2250±283	1582±578
ASPECT (most common)	SW	SSW	SE-W	SE-SW	SW	SE-SW	ALL	ALL		ALL
SLOPE (%)	44±23	49±19	43±25	53±19	42±24	43±26	32±23	46±25	35±43	30±22
TOPOGRAPHIC MOISTURE ²	5.2±.9	5.3±1.1	5.9±.9	5.5±.9	5.5±1.1	5.4±1.1	6.5±.6	6.3±.8	7.0±1.4	6.9±.8
SOIL TEMPERATURE ³	13.6±2.7	11.5±1.9	11.1±1.9	12.6±1.0	11.8±1.6	9.8±.81	12.2±2.1	11.2±1.8	9.5	12.5±15.0
TOP HEIGHT ⁴ (ft)	144±31	170±32	162±39	197±38	208±34	168±27	206±44	205±43	180	188±59
BASAL AREA ⁴ (ft ³ /ac)	366±98	411±103	416±100	366±162	392±76	393±62	371±98	421±15	362	336±100
SITE INDEX ⁵	110±30	133±26	132±31	160±23	159±24	131±22	174±27	181±17	142	170±47
EST. YIELD ⁶ (ft ³ /ac/yr)	100	135	135	170	170	132	185	191	148	181

1 Values are ± one standard deviation.

2 Relative scale with 1=no water storage capacity and 9=aquatic. Reflects topographic redistribution of groundwater.

3 Mean soil temperature at 8" (20 cm.) in centigrade measured during the summer months.

4 Values from old growth stands.

5 100 yr. base (McArdle and Meyer, 1930.)

6 Estimated relative productivity for comparisons only.

TABLE VII. Average Coverage Values for Associations in the *Tsuga heterophylla* Series.
 "." indicates a coverage less than .5 percent. "1" indicates a coverage of .5 to 1.5 percent.
 ZERO values are included in the averages.

	TSHE/ GASH n=10	TSHE/ BENE n=14	TSHE/ DEPA n=13	TSHE/ SMST n=3	TSHE/ POMU-BENE n=9	TSHE/ POMU-GASH n=7	TSHE/ VAAL n=8	TSHE/ POMU n=12	TSHE/ POMU-TIUN n=16	TSHE/ OPHO n=5
TREES										
ABAM	. (30)	1 (29)	1 (31)	1 (67)	1 (33)		5 (88)	2 (25)	3 (44)	3 (40)
PSME	30 (90)	36 (93)	37 (92)	50 (100)	44 (100)	51 (100)	18 (100)	26 (75)	26 (56)	27 (60)
TABR	2 (40)	4 (50)	3 (38)		6 (56)	1 (14)	8 (63)	5 (33)	3 (31)	3 (40)
THPL	26 (100)	29 (100)	30 (100)	2 (33)	27 (89)	39 (100)	25 (100)	38 (92)	32 (100)	24 (100)
TSHE	65 (100)	63 (100)	58 (100)	53 (100)	55 (100)	46 (100)	70 (100)	43 (100)	59 (100)	57 (100)
SHRUBS AND HERBS										
ACCI	2 (30)	6 (57)	4 (31)	11 (100)	10 (56)	16 (71)	18 (63)	19 (67)	23 (88)	18 (80)
ACTR					. (11)				. (6)	
ATFI			. (31)	1 (100)	. (33)	. (29)	1 (50)	1 (58)	6 (75)	21 (100)
BENE	9 (90)	12 (100)	5 (92)	1 (33)	12 (100)	7 (86)	1 (50)	1 (50)	5 (56)	1 (80)
BLSP	. (30)	. (7)	. (15)		1 (56)	. (29)	2 (75)	2 (67)	2 (75)	1 (40)
CHME	. (30)	. (36)	1 (77)	. (33)	. (33)	. (43)	. (38)		. (13)	. (20)
CHUM	1 (90)	1 (64)	1 (38)		. (22)	1 (57)	. (25)		. (6)	
CLUN	. (20)	1 (50)	. (15)	1 (67)	. (33)	. (43)	1 (63)	. (17)	1 (44)	1 (60)
COCA	. (20)	. (36)	. (23)		. (29)	. (29)	2 (88)	. (25)	1 (50)	1 (40)
GASH	47 (100)	2 (43)	1 (54)		1 (22)	17 (100)	6 (88)	. (25)		. (20)
GOOB	1 (50)	1 (64)	1 (62)		1 (56)	1 (57)	1 (63)	. (33)	. (44)	
GYDR			. (31)		. (22)	. (14)	1 (13)	1 (58)	1 (56)	1 (60)
HODI				. (33)				. (8)	. (6)	
LIBO2	3 (90)	3 (79)	2 (62)		2 (78)	1 (86)	3 (75)	. (33)	2 (50)	1 (40)
MADI									. (13)	4 (20)
MEFE		. (7)			. (11)	. (29)	. (13)	. (8)	. (13)	. (20)
OPHO		. (14)	. (15)		1 (44)	2 (29)	1 (25)	1 (67)	2 (69)	13 (100)
OSCH			. (8)	. (33)	. (11)				. (19)	. (20)
PAMY	. (20)	1 (36)	. (31)			. (29)		. (8)	. (6)	. (20)
POMU	. (40)	1 (79)	2 (46)	2 (100)	28 (100)	21 (100)	2 (63)	54 (100)	40 (100)	36 (100)
PTAQ	. (20)	1 (36)	. (31)			1 (43)		. (8)	. (6)	
PYSE	. (10)	. (21)	. (31)		. (11)	. (29)	. (13)			
ROGY	. (10)		. (23)	1 (67)	1 (22)	. (14)		. (17)	. (25)	
RUPE		. (21)	. (8)				. (38)		. (25)	1 (40)
RUSP	. (20)	. (7)	. (15)		. (33)	1 (29)	1 (50)	. (17)	1 (44)	1 (40)
SMST		. (7)	. (8)	13 (100)	. (22)		. (25)	. (8)	. (44)	3 (40)
STRO			. (8)	. (33)	. (11)		. (13)	. (25)	. (19)	. (20)
TITR			. (8)	3 (33)	. (22)		. (13)	1 (50)	1 (38)	1 (60)
TIUN	. (10)	. (43)	. (23)	1 (33)	1 (89)	. (14)	1 (38)	1 (50)	7 (88)	9 (80)
TRLA2	. (20)	. (14)	. (23)	1 (67)	1 (44)	. (43)	. (13)	1 (50)	. (38)	. (20)
TROV		. (36)	. (23)		1 (56)	1 (71)	. (25)	1 (75)	1 (88)	1 (40)
VAAL		1 (43)	. (31)		1 (44)	. (14)	18 (100)	1 (50)	2 (50)	2 (20)
VAPA	3 (100)	1 (79)	1 (69)	1 (67)	7 (67)	2 (100)	5 (100)	1 (75)	3 (75)	2 (80)
WISE	. (30)	1 (57)	1 (54)	1 (100)	1 (67)	1 (100)	1 (50)	. (33)	1 (56)	. (20)

Tsuga heterophylla/Oplopanax horridum (Western hemlock, Devil's club, Tshe/Opho) Association.

The Tsuga heterophylla/Oplopanax horridum Association occurs in patches and stringers along first, second and third order streams on wet toe slopes and around springs on mid-slopes. Eighteen plots were sampled in this area which averaged 1582 feet (482 m) elevation. Slopes were either moderate (30%) or nearly flat. Aspect is variable and is not as important as topographic position relative to streams.

Fire and Wind Disturbance

Because of the wet nature of the Tshe/Opho habitat type and the lushness of the associated plants, this type is often protected from fire.

Species Composition and Succession

Western hemlock (Table VIII) dominates the tree layers. Douglas fir and, western red cedar are also important overstory species especially in old growth. Silver fir may be present in some old growth stands. Small amounts of Douglas-fir and silver fir may be encountered in the old-growth communities. In the ground vegetation layers, Oplopanax horridum, Ribes bracteosum, Rubus spectabilis, Vaccinium alaskaense and Acer circinatum dominate. Numerous wet site herbs occur beneath the shrubs. These include Athyrium filix-femina, Blechnum spicant, Maianthemum dilatatum, Tiarella unifoliata and Polystichum munitum.

Timber Productivity

Timber productivity potential in this type is difficult to assess because of the patchy nature of the communities and the influence of adjacent streams. Site index indicators are generally high averaging 170 feet (52 m) at 100 years. Sites with Douglas-fir are highest while others are poorer, possibly because of disease or disturbance factors. Stocking in old-growth communities appears to be somewhat limited with only 336 ft²/ac of basal area estimated. This type tends to be patchy, however, under management this type may prove to be one of our more productive.

Wildlife Relations

Potential for wildlife values in this type is high. Because of the limited elk herds in areas where this type is more common, utilization is low. Deer may utilize this type for cover and food at certain times of the year, especially winter and early spring. Undoubtedly many non-game species seek food, cover and water here.

Distribution and Relation to Other Types

This type is now widely recognized in Western Washington, but not elsewhere. Franklin et al. (1979) recognized it as a common river bottom component of Mount Rainier National Park. Henderson and Peter (1981a, b, d; 1982; 1983; 1984) have identified this type in areas already covered in this study.

Tsuga heterophylla/Gaultheria shallon (Western hemlock/Salal, Tshe/Gash) Association.

The Tsuga heterophylla/Gaultheria shallon Association is one of the most frequently encountered in Western Washington. On the Mt. Baker district it is restricted to topographically or edaphically dry sites - mostly on till. It is found in environmental zones 8-10 (Figure 7). Average elevation of 38 plots in this type in this area was 2025 feet (617 m). Slope averaged 44% on southerly to westerly aspects including several plots on gentle slopes on glacial till. Soils are well drained, often cobbly or gravelly sandy loams. Soil temperature data from 15 m (8 inches) indicates that this is the warmest type in the western hemlock series. The most common soil mapping unit encountered was SMU 81 (Snider and Wade 1970). Other soils include 12, 37, 71, 81, 54, 13, 70, 21 and 72.

Fire and Disturbance History

Fire history in the Tshe/Gash type is fairly well established for western Washington. Regionally this type burns frequently (about every 150-200 years) and constitutes most of the high fire hazard areas. In the study area it occurs on drier slopes and microsites in areas most frequently burned. Sampled stands represent fires that burned mostly about 100 and 450 years ago. Relatively few stands of this type throughout the Cascades escaped burning during the period 240-320 years ago except on this District where the Mt. Baker and Darrington Districts this burning period is nearly absent. As in most Tshe types in this area wind is not a consistent disturbance factor.

Species Composition and Succession

The Tshe/Gash type is easily identified by the presence of hemlock regeneration and the dominance of salal (Gash) in the understory. Douglas-fir is the major seral species on this type. Seral hardwoods (Alru, Acma and Rhpu) are usually rare or absent. Hemlock assumes dominance of this type as stands move closer to old-growth condition. Late in the sere western redcedar becomes noticeable in the community and by near-climax stages becomes codominant with hemlock.

In the ground vegetation layers few species seem to be able to compete with salal when it takes hold of the site (Table VIII). Red huckleberry (Vapa), Oregongrape (Bene), vine maple (Acci) and twin flower (LIB02) are usually found associated with salal on the Tshe/Gash h.t. In moister areas or on moister microsites in this type Alaska huckleberry (Vaal) or swordfern are sometimes found.

Timber Productivity

Timber productivity in the Tshe/Gash h.t. is moderate. However, there is considerable variability within this type over its range depending on whether it develops on well drained but also well-watered sites (high productivity) or excessively well drained but not well watered (low productivity) sites.

High productivity Tshe/Gash sites often have small quantities of swordfern or twinflower. Site index for stands in this area from McArdle and Meyer (1930) averaged 110 feet (34 m) while the height of old-growth Douglas-fir trees was 144 feet (Table VI). Basal area was high in sampled stands averaging 366 ft²/ac (84 m²/ha) in old-growth. This points out the interesting inverse relationship between site index and basal area noticed by others in other areas.

In wild stands there can be a greater basal area accumulation, in stands with a lower site index. A similar relationship is reported by Miles Hemstrom (personal communication) between the drier Cascades and the moister Coast Range of Oregon.

Generally, Douglas-fir is the preferred timber species. Western hemlock may be able to keep up with Douglas-fir on some sites, but is generally inferior to Douglas-fir on the Tshe/Gash type. Western redcedar can be considered here. Some preliminary results indicate that this is one type which responds well to fertilizer. Because of the stocking relationship mentioned above, special care (thinning) is sometimes needed to keep these stands from overstocking or even stagnating. This is especially true on drier sites in this type.

Wildlife Relations

This type provides some winter range, hiding and thermal cover and forage for both deer and elk. However, throughout its range deer seem to use the type more than elk. The shrubs found in this type provide some year-around browse, as the type is usually snow-free much of the winter. Overall importance of this widespread type for ungulates is moderate for deer and low for elk.

Relation to Other Types

The Tshe/Gash Association is widely recognized and is one of the most common types in Western Washington and Oregon. Many authors make reference to this type including Spillsbury and Smith (1947); Eis (1962); Dyrness et al. (1974); Franklin and Dyrness (1973); Franklin et al. (1979); Henderson et al. (1979); Henderson and Peter, (1981a, b, c, d); (1982a,b,); (1983a, b); (1984).

Tsuga heterophylla/Polystichum munitum-Gaultheria shallon (Western hemlock/
Swordfern-Salal, Tshe/Pomu-Gash) Association

The Tsuga heterophylla/Polystichum munitum-Gaultheria shallon Association is not common on the Mt. Baker District. It is found throughout the Forest but usually it is not encountered as large stands. It was previously considered an intergrade between the Tshe/Pomu and Tshe/Gash types. However, it is more common than previously thought. Also Pomu and Gash types are being broken down into smaller and more homogeneous units, and the Pomu-Gash type is a logical result of this process. It is recognized on the Mt. Baker District from 26 plots of which several are old growth.

Productivity indicators and management implications are intermediate between the Tshe/Pomu and the Tshe/Gash Associations. Site index for this type is 159 and estimated yield is 170^3 ft/ac/yr. The basal area averaged 392 sq. ft./acre.

This type was previously recognized in the Darrington District (Henderson and Peter, 1984).

Tsuga heterophylla/Vaccinium alaskaense (Western hemlock/Alaska huckleberry, Tshe/Vaal) Association.

The Tsuga heterophylla/Vaccinium alaskaense Association occurs in two situations, one along streamcourses and another on upper slopes just below the silver fir zone. These sites are higher elevation and cooler than Tshe/Pomu, drier than Tshe/Opho and without the winter snowpacks of the Abam/Vaal type. They probably represent two different plant Associations but so far we are unable to recognize any consistent floristic indicators. The stream bottom "type" has higher productivity. Average elevation was 2079 feet (634 m) for eighteen plots. Slopes were southwest or southeast or stream bottoms and averaged 43%. Soil temperature data from 15 m. (8 inches) indicates that this is the coolest type in the western hemlock series.

Fire and Disturbance History

The Tshe/Vaal Association develops on moist and often protected sites and is much less prone to burn than the Tshe/Gash, Tshe/Bene or Tshe/Dep. types. Ages of pre-management forests indicate fires about 250 and 650 years ago.

Species Composition and Succession

Western hemlock is the dominant tree species on this type even in seral stands. Douglas-fir had up to 30% cover in young (planted) stands but was reduced to 18% in old-growth stands. Western redcedar (25%) and small amounts of silver fir are usually present. The presence of silver fir points up the similarity between this type and the Abam/Vaal type.

Alaska huckleberry is at least codominant in the ground vegetation layers, even early in the sere. Other moist site species such as Oplopanax horridum, Rubus spectabilis, Blechnum spicant and Athyrium filix-femina are often present in the stream bottom type. Chimaphila umbellata, Cornus canadensis and Rubus pedatus are found in upper slope stands. One phase of the slope stands contains significant amounts of Gaultheria shallon but a large enough sample was not accumulated to warrant creating a new type.

Timber Productivity

Timber productivity estimators for most areas indicate a good potential. However, some stands at higher elevations in this area were quite low. Average site index (McArdle and Meyer (1930) was 131 feet (40 m). Estimated yield (Table VI) is 132 ft³/ac/yr. Average top height of old-growth stands was 168 feet (51 m). Basal area in old-growth stands averaged 393 ft²/ac (90 m²/ha).

Wildlife Relations

Many preferred browse species occur in seral as well as old-growth stages of this Association. If elk are present, this can represent prime winter range habitat. In the Olympics resident year-round elk herds reside in this type (Kurt Jenkins, personal communication). This type represents good potential Roosevelt elk habitat, although elk are absent from most of the study area. It is moderate to good deer winter range.

Tsuga heterophylla/Polystichum munitum (Western hemlock/Swordfern, Tshe/Pomu) Association.

The Tsuga heterophylla/Polystichum munitum Association is a common and highly productive type of moist and usually toe slope positions. It occurs typically where there is subsurface water supplied to the site, usually on southerly aspects in high precipitation areas and on northerly aspects in drier areas. It is drier than Tshe/Opho and moister than Tshe/Gash and warmer than Tshe/Vaal. Average elevation in this area was 1382 feet (421 m). Slopes averaged 32%. Fifty-three plots were taken in this area (Table VI), 12 of which represented old-growth conditions.

Fire and Disturbance History

Many stands in this type appear to have originated following fires about 158, 300 and 450 years ago. The latter are two of the major burning periods already recognized for Western Washington. The numerous other young-growth samples in this type date from early railroad logging to modern timber cutting. Most of this type was cut over early, as it was both accessible, and contained large timber volumes. Because of the moistness of this kind of site and the lushness of many of its constituent ground vegetation species fires have probably burned less frequently in this type than the average for the Tshe zone. This too may account for the high volumes on this type in virgin forests.

Species Composition and Succession

Douglas-fir (Psme) and alder (Alru) are the major seral species while western hemlock (Tshe) is the dominant old-growth species, although it too plays an important role in some early seral stands. Western redcedar is also a minor component of the old-growth communities. In early successional stages the ground vegetation layer is dominated by herbaceous species such as trailing blackberry (Ruor), velvet grass (Holo), pearly everlasting (Anma), and cat's ear (Hyra). Later stages are clearly dominated by swordfern (Pomu). Other species which may be encountered include red huckleberry (Vapa), salal (Gash), deerfern (Blsp), foamflower (Titr), and Vine maple (ACCI).

Timber Productivity

Timber productivity potential on the Tshe/Pomu habitat type is high. Site index using the curves of McArdle and Meyer (1930) averaged 174. Gross volume at 100 years is estimated to be about 17,000 ft³/ac. Basal area of old-growth stands averaged only 371 ft²/ac (85 m²/ha). Wild stands in this type can show surprisingly low basal areas. We do not know at this time whether this represents a stockability limitation of this kind of site or a stocking due to stand history. The brush competition problems often encountered on this type from alder, salmonberry and vine maple suggest young wild stands do not always become fully stocked, and then as these other species fade from the community, Douglas-fir is not able to fill-in the vacated space in the community, although hemlock and cedar would gradually come in. This would yield few, widely spaced, fast growing trees in a stand which might never be able to "fully occupy" the site. If this is the case, management through stocking control should be able to increase the yield of this habitat type over what wild stands have produced.

Wildlife Relations

The Tshe/Pomu Association in typical old-growth condition provides some cover and forage for large ungulates. Animals will feed on the swordfern (Pomu) if other species are lacking. Also, red huckleberry (Vapa), foamflower (Titr), Devil's club (Opho), and salmonberry (Rusp) may be present in small quantities and utilized.

Seral stages on the Tshe/Pomu h.t., in contrast, often provide good forage, especially in the spring and late winter when food is often limiting. Red alder (Alru), salmonberry (Rusp) plus many forbs and grasses can dominate these stands.

Relation to Other Types

The Tshe/Pomu Association is widely recognized and is one of the most common types in Western Washington and Oregon. Many authors refer to this type including Spilsbury and Smith (1947) (swordfern site type); Eis (1962) (Polystichum Association), Franklin and Dyrness (1973); Dyrness et al. (1974); Franklin et al. (1979); Henderson et al. (1979) (Psme-Tshe/Pomu-Oxor c.t.); Henderson and Peter (1981a, b, c, d); Henderson and Peter (1982a,b, 1983a, b, 1984).

Tsuga heterophylla/Berberis nervosa (Western hemlock/Oregongrape, Tshe/Bene) Association.

The Tsuga heterophylla/Berberis nervosa Association is a minor type for this area. It is recognized from 14 old-growth and 10 young communities. It often occurs at the upper elevational range of Tshe/Pomu to which it is related. It is also similar to Tshe/Gash but perhaps occurring on finer textured soils. Sometimes it occurs in well-drained topographic positions. It appears to be absent from low environmental zones (i.e. high precipitation areas).

Douglas-fir, western hemlock and western redcedar are dominant trees. Ground vegetation is characterized by Berberis nervosa, Chimophila umbellata, Acer circinatum, Linnaea borealis, Polystich munitum, Vaccinium parvifolium, Gaultheria shallon and Viola sempervirens.

Average site index is about 133 feet (41 m) at 100 years. Volume productivity potential is low for the western hemlock zone or about 135 ft³/ac/yr (Table VII). Wildlife and recreational values are moderate to low.

The Tshe/Bene Association is recognized for the White River and southern North Bend and Darrington Districts (Henderson and Peter 1981c, d, 1984). In those areas it is a drier type usually without vine maple and with a more depauperate understory. It was not recognized in Mount Rainier National Park by Franklin et al. (1979). Dyrness et al. (1974) recognize the Pseudotsuga menziesii/Acer circinatum/ Berberis nervosa community type in the Central Cascades in Oregon. Henderson et al. (1979) report an Abgr/Acci-Bene and a Tshe-Psme/Acci-Bene community type in the Olympics.

Tsuga heterophylla/Depauperate (Western hemlock/Depauperate, Tshe/Dep.) Association

The Tsuga heterophylla/Depauperate Association is usually found at upper elevations in the Tshe zone where it averaged 2317 feet (706 m) in this area. It occurs on all aspects but favors south and west aspects. It occurs mostly on drier upper slope positions or steep, well-drained lower slope positions. Average slope was 43%. Thirty plots including 13 old-growth plots were sampled. Average total understory cover in these plots was 12% if vine maple coverage is included but only 6% without it. This type is found more commonly in drier parts of the study area i.e. Environmental Zones 8-10 (Figures 8 and 9).

Fire History

Fires are moderately common on this type. Ages of stands suggests that much of it was burned ca. 200 and 450 years ago. Topographically and climatically this type occurs in areas one would expect to be more prone to fires than the average.

Species Composition and Succession

There is little to be said about the ground vegetation in this type except that there isn't much. In the tree layers Douglas-fir, western hemlock and western red cedar dominate. In the ground vegetation layers Acer circinatum, Berberis nervosa, Chimophila menziesii, Goodyeara oblongifolia, Gaultheria shallon, V. parvifolium, Polystichum munitum and Viola sempervirens are often present.

Timber Productivity

Timber productivity potential is moderate, about the same as the Tshe/Bene type to which it is closely related. McArdle and Meyer (1930) site index averaged 132 feet (40 m) at 100 years. Basal area stockability is moderate to high for this area with old-growth stands averaging 416 ft²/ac (91 m²/ha). Estimated volume at culmination was 8400 ft³/ac. Other estimators of stockability (GBA, SDI, etc.) may show this type to have a low growth stockability and that these old-growth stands exhibit quite an excess over what is desirable under management.

Distribution and Relation to Other Types

This type is not generally recognized as a kind of ecological site as it is here. In Canada, however, Eis (1962) recognized a "moss" type while others have referred to a "nudum" type. Usually stands with depauperate understory have been considered anomalies of stand history or current (cover) stocking. It was recognized for the Soleduck District, Olympic National Forest, by Henderson and Peter (1982a), for the Hoodport and Quilcene Districts (1983a) for the Skykomish District and the Darrington District, Mt. Baker-Snoqualmie N.F. (1983b, 1984.).

Tsuga heterophylla/Tiarella trifoliata - Gymnocarpium dryopteris
(Western Hemlock/Foamflower-Oakfern, Tshe/Titr-Gydr)
Association

The Tsuga heterophylla/Tiarella trifoliata-Gymnocarpium dryopteris association is recognized on the Mt. Baker District from two plots one of which was old growth. These two plots averaged 2250 feet elevation on 35% slopes. Here, as elsewhere where it has been found it is a minor association found on moist, toeslope and river bottom positions.

This has been considered one of the more productive associations of the western hemlock series but the average site index of these plots was only 142. Their average basal area was 362 square feet per acre.

The Tsuga heterophylla/Tiarella trifoliata - Gymnocarpium dryopteris association shows some affinities to the western hemlock/swordfern types. The overstory is dominated by western hemlock and western red cedar with small amounts of Douglas fir. The major several species is red alder. The shrub layer is sparse but includes Acer circinatum and Oplopanax horidum. The herb layer is frequently rich and includes Tiarella trifoliata and unifoliata, Gymnocarpium dryopteris, Polystichum munitum, and Blechnum spicant.

The Tsuga heterophylla/Tiarella trifoliata - Gymnocarpium dryopteris association has been reported for the White River District (Henderson and Peter 1981), and the Snoqualmie and adjacent Skykomish River Drainages (Henderson and Peter, 1982) on the Mt. Baker-Snoqualmie National Forest. It is also to be expected elsewhere on the forest but probably only in small quantity.

Tsuga heterophylla/Polystichum munitum - Tiarella trifoliata
(Western hemlock/swordfern - foamflower, Tshe/Pomu-Titr)

The Tsuga heterophylla/Polystichum munitum - Tiarella trifoliata association is recognized on the Mt. Baker District for the first time based on 26 plots of which 16 are old growth. It was previously considered a high productivity phase of Tsuga heterophylla/Polystichum munitum. It is not a widespread type but significant enough on the Mt. Baker District to warrant establishing it as a type. It is a type of well watered but well drained lower slopes and toe slopes. Average elevation for this type is 1680 feet. It occurs on all aspects on an average slope of 46%.

The overstory is dominated by western hemlock with smaller amounts of western red cedar and douglas fir in the old growth condition. Small amounts of silver fir will occasionally be found. The shrub layer is dominated by Acer circinatum and lesser amounts of Berberis nervosa, Vaccinium alaskaense and Vaccinium parvifolium. The herb layer is rich and includes Polystichum munitum, Athyrium filix-femina, Blechnum spicant, Linnaea borealis and Tiarella trifoliata and unifoliata. Pioneer tree species are the same as for Tsuga heterophylla/Polystichum munitum - red alder, Douglas fir and western hemlock.

This association has affinities to the Tsuga heterophylla/Polystichum munitum association and the Tsuga heterophylla/Tiarella unifoliata - Gymnocarpium dryopteris association but is more productive than either. It is on the moist side of Tsuga heterophylla/Polystichum munitum but not so moist and better drained than the Tsuga heterophylla/Oplopanax horridum association.

Tsuga heterophylla/Polystichum munitum - Berberis nervosa
(Western hemlock/swordfern - Oregon grape, Tshe/Pomu-Bene)
Association

The Tsuga heterophylla/Polystichum munitum-Berberis nervosa association is recognized on the Mt. Baker district for the first time based on 25 plots of which 14 are old growth. It was previously considered an intergrade between Tsuga heterophylla/Polystichum munitum and Tsuga heterophylla/Berberis nervosa. It occurs primarily on southeast and southwest aspects at an average elevation of 1755 feet and an average slope of 53%.

The overstory is dominated by western hemlock and Douglas fir with lesser amounts of western red cedar. The shrub layer consists mostly of Acer circinatum, Berberis nervosa, and Vaccinium parvifolium while common herbs are Polystichum munitum, Linnaea borealis, Tiarella unifoliata and Viola sempervirens.

Productivity is almost the same as for Tsuga heterophylla/Polystichum munitum Gaultheria shallon. The old growth site index averaged 160, the basal area averaged 366 square feet/acre and the estimated yield per acre is 170 cubic feet.

This type has strong affinities to the Tsuga heterophylla/Polystichum munitum association with which it was formerly combined as a lower productivity phase. It also has some affinities to the Tsuga heterophylla/Polystichum munitum Gaultheria shallon association. Both are drier than the Tsuga heterophylla/Polystichum munitum association but Tsuga heterophylla/Polystichum munitum-Berberis nervosa is cooler than Tsuga heterophylla/Polystichum munitum - Gaultheria shallon.

Tsuga heterophylla/Lysichitum americanum
(Western Hemlock/Skunk cabbage, TSHE/LYAM
Association

The Tsuga heterophylla/Lysichitum americanum association is recognized on the Mt. Baker District from one plot in the Suiattle Valley. It is an association of very limited distribution that appears in low, very wet areas. Though this is the first time it has been described for the Mt. Baker-Snoqualmie or Olympic National Forests it has been observed elsewhere in both forests. It is an association of extremely poorly drained areas which have standing water much or all of the year.

Due to the poor drainage productivity on these sites is probably limited, however they generally occupy rather small spots in the landscape and may therefore be of little consequence in this regard. There may, however, be special problems associated with operability or regeneration in and around this type.

The Tsuga heterophylla/Lysichitum americanum association is readily identifiable by the presence of 5% cover of Lysichitum americanum which is often present even early in the sere. The overstory is dominated by Tsuga heterophylla with lesser amounts of Thuja plicata. Other understory species frequently encountered include Rubus spectabilis, Polystichum munitum, Blechnum spicant and Tiarella trifoliata although all of these species would occur more on the edge of the community in slightly elevated positions with the possible exception of Rubus spectabilis.

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APPENDIX

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Threatened, Endangered and Sensitive Plants, Darrington District, Mt. Baker-Snoqualmie National Forest.

There are 36 plant species or varieties on the Regional Forester 1985 Sensitive Plant List that occur on or adjacent to the Mt. Baker-Snoqualmie National Forest. These species are listed in Table VIII. At this time there are also 5 Plant Taxa which are listed as threatened.

Habenaria orbiculata (Platanthera orbiculata) Previously listed as sensitive has been dropped from the list. It is more common than previously thought.

The five threatened species found on or near the Mt. Baker Snoqualmie N.F. are: Aster curtus, Carex pauciflora, Castilleja cryptantha, Platanthera chorisiana and Pleuricospora fimbriolata. Knowledge of these species is limited. Only C. pauciflora is believed to occur on the Mt. Baker District. A. curtus occurs in lowlands nearby; C. cryptantha is found in Mt. Ranier N.P., P. chorisiana is a mountain bog plant found to the north and to the south and P. fimbriolata is known south of the area in forest habitats.

TABLE VIII. SENSITIVE PLANTS MT. BAKER-SNOQUALMIE NATIONAL FOREST, based on Regional Forester's Advice 1985.

Arenaria paludicola	Lobelia dortmanna
TAster curtus	Loiseleuria procumbens
Aster sibiricus	Luzula arcuata
Boytrychium boreale	Lycopodium alpinum
Boytrychium lanceolatum	Lycopodium dendroideum
Botrichium lunaria	Microseris borealis
Var. Onondagensea	Pedicularis rainierensis
Botrichium matricariifolium	TPleuricospora fimbriolata
Calamagrostis crassiglumis	Ranunculus cooleyae
Campanula lasiocarpa	Salix vestita
Carex comosa	Saxifraga cernua
Carex macrochaeta	Saxifraga debilis
TCarex pauciflora	Saxifraga integrifolia apetala
Carex saxatilis var. major	
Carex scirpoidea scirpoidea	
Carex stylosa	
TCastilleja cryptantha	
Chaenactis Thompsonis	
Cimicifuga elata	
Coptis asplenifolia	
Dodecatheon pulchellum	
Var. watsonii	
Dryas drummondii	
Frillaria camschatcensis	
Gentiana douglasiana	
Gentiana glauca	
THabenaria chorisiana (Platanthera c.)	

T Listed in Washington Natural Heritage program, 1982 as Threatened.

TABLE IX. COMMONLY OCCURRING PLANTS OF FORESTED HABITATS ON THE MT.
BAKER-SNOQUALMIE NATIONAL FOREST

TREES

TRI code	Scientific Name	Common Name
ABAM	<i>Abies amabilis</i>	Pacific silver fir
ABGR	<i>Abies grandis</i>	Grand fir
ABLA2	<i>Abies lasiocarpa</i>	Subalpine fir
ABPR	<i>Abies procera</i>	Noble fir
ACMA	<i>Acer macrophyllum</i>	Bigleaf maple
ALRU	<i>Alnus rubra</i>	Red alder
CHNO	<i>Chamaecyparis nootkatensis</i>	Alaska yellowcedar
PIEN	<i>Picea engelmannii</i>	Englemann spruce
PISI	<i>Picea sitchensis</i>	Sitka spruce
PIAL	<i>Pinus albicaulis</i>	Whitebark pine
PIMO	<i>Pinus monticola</i>	Western white pine
POTR2	<i>Populus trichocarpa</i>	Black cottonwood
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir
RHPU	<i>Rhamnus purshiana</i>	Cascara buckthorn
SASC	<i>Salix scouleriana</i>	Scouler willow
TABR	<i>Taxus brevifolia</i>	Pacific yew
THPL	<i>Thuja plicata</i>	Western redcedar
TSHE	<i>Tsuga heterophylla</i>	Western hemlock
TSME	<i>Tsuga mertensiana</i>	Mountain hemlock

SHRUBS

ACCI	<i>Acer circinatum</i>	Vine maple
ACGL	<i>Acer glabrum</i>	Rocky Mt. maple
ALSI	<i>Alnus sinuata</i>	Sitka alder
AMAL	<i>Amelanchier alnifolia</i>	Saskatoon, serviceberry
ARCO3	<i>Arctostaphylos columbiana</i>	Hairy manzanita
ARUV	<i>Arctostaphylos uva-ursi</i>	Bearberry, Kinnikinnick
BENE	<i>Berberis nervosa</i>	Low Oregon grape
CAME	<i>Cassiope mertensiana</i>	White Mt. heather
COCO	<i>Corylus cornuta</i>	California hazelnut
CONU	<i>Cornus nutallii</i>	Pacific dogwood
GASH	<i>Gaultheria shallon</i>	Salal
HODI	<i>Holodiscus discolor</i>	Oceanspray
JUCO4	<i>Juniperus communis</i>	Common juniper
LOIN	<i>Lonicera involucrata</i>	Black twinberry
MEFE	<i>Menziesia ferruginea</i>	Rusty menziesia, Fool's huckleberry
OECE	<i>Oemleria cerasiformis</i>	Indian plum
OPHO	<i>Oplopanax horridum</i>	Devil's club
PAMY	<i>Pachistima myrsinites</i>	Myrtle pachystima, Mt. lover
PHEM	<i>Phyllodoce empetrifomis</i>	Red mountain heather
PREM	<i>Prunus emarginata</i>	Bitter cherry

TRI code	Scientific Name	Common Name
RHAL	Rhododendron albiflorum	Cascades azalea, white rhododendron
RIBR	Ribes bracteosum	Stink currant
RIHO	Ribes howellii	Mapleleaf currant
RILA	Ribes lacustre	Prickly currant
RISA	Ribes sanguineum	Red-flowering currant
RIVI	Ribes viscosissimum	Sticky currant
ROGY	Rosa gymnocarpa	Baldhip rose
RONU	Rosa nutkana	Nootka rose
RULE	Rubus leucodermis	Whitebark raspberry, Blackcap
RUPA	Rubus parviflorus	Western thimbleberry
RUSP	Rubus spectabilis	Salmonberry
SARA	Sambucus racemosa	Coast red elderberry
SOSC2	Sorbus scopulina	Cascade mountain ash
SOSI	Sorbus sitchensis	Sitka mountain ash
SPDE	Spiraea densiflora	Subalpine spiraea
SPDO	Spiraea douglasii	Douglas spiraea
SYAL	Symphoricarpos albus	Common snowberry
SYMOH	Symphoricarpos mollis hesperius	Creeping snowberry
VAAL	Vaccinium alaskaense	Alaska huckleberry
VADE	Vaccinium deliciosum	Blue-leaf huckleberry
VAME	Vaccinium membranaceum	Thin-leaved huckleberry
VAOV	Vaccinium ovalifolium	Oval-leaf huckleberry
VAOV2	Vaccinium ovatum	Evergreen huckleberry
VAPA	Vaccinium parvifolium	Red huckleberry
VASC	Vaccinium scoparium	Grouse whortleberry

HERBS

ACMI	Achillea millefolium	Western yarrow
ACTR	Achlys triphylla	Vanillaleaf
ACRU	Actaea rubra	Baneberry
ADBI	Adenocaulon bicolor	Pathfinder
ADPE	Adiantum pedatum	Maidenhair fern
ANMA	Anaphalis margaritacea	Common pearly-everlasting
ANLY2	Anemone lyallii	Nine-leaved anemone
ANOR	Anemone oregana	Oregon anemone
ANLY	Angelica lyallii	Lyall's angelica
ANMI	Antennaria microphylla	Rosy pussy-toes
AQFO	Aquilegia formosa	Red columbine
ARLE	Arabis lemonii	Lemon's rockcress
ARMA3	Arenaria macrophylla	Bigleaf sandwort
ARCO	Arnica cordifolia	Heartleaf arnica
ARLA	Arnica latifolia	Broadleaf arnica
ASCA3	Asarum caudatum	Wildginger
ATFI	Athyrium filix-femina	Lady fern
BLSP	Blechnum spicant	Deer fern
BRSI	Bromus sitchensis	Alaska brome
BRVU	Bromus vulgaris	Columbia brome
CABI	Caltha biflora	White marshmarigold

TRI code	Scientific Name	Common Name
CASC2	<i>Campanula scouleri</i>	Scouler's hairbell
CADE	<i>Carex deweyana</i>	Dewey's sedge
CAGE	<i>Carex geeyeri</i>	Elk sedge
CAIN5	<i>Carex interior</i>	Inland sedge
CAME2	<i>Carex mertensii</i>	Merten's sedge
CLUN	<i>Clintonia unifora</i>	Queen's cup
COLA	<i>Coptis laciniata</i>	Cutleaf goldthread
COMA3	<i>Corallorhiza maculata</i>	Spotted coral-root
COME	<i>Corallorhiza mertensiana</i>	Merten's coral-root
COST2	<i>Corallorhiza striata</i>	Striped coral-root
COCA	<i>Cornus canadensis</i>	Bunchberry
COSC	<i>Corydalis scouleri</i>	Scouler's corydalis
DIFO	<i>Dicentra formosa</i>	Pacific bleedingheart
DIPU	<i>Digitalis purpurea</i>	Foxglove
DIHO	<i>Disporum hookeri</i>	Hooker's fairybell
DISM	<i>Disporum smithii</i>	Smith fairybell
DRAU2	<i>Dryopteris austriaca</i>	Spreading woodfern
EPAN	<i>Epilobium angustifolium</i>	Fireweed
EPGL	<i>Epilobium glaberrimum</i>	Common willow-herb
EPMI	<i>Epilobium minutum</i>	Small-flowered willow-herb
EPPA	<i>Epilobium paniculatum</i>	Autumn willow-herb
EQAR	<i>Equisetum arvense</i>	Common horsetail
ERGR	<i>Erythronium grandiflorum</i>	Yellow fawnlily
ERMO	<i>Erythronium montanum</i>	Avalanche fawnlily
EROR	<i>Erythronium oregonum</i>	Giant fawnlily
FERU	<i>Festuca rubra</i>	Red fescue
FRVE	<i>Fragaria vesca</i>	Woods strawberry
FRVI	<i>Fragaria virginiana</i>	Broadpetal strawberry
GAAP	<i>Galium aparine</i>	Catchweed bedstraw
GAOR	<i>Galium oregonum</i>	Oregon bedstraw
GATR	<i>Galium triflorum</i>	Fragrant bedstraw
GOOB	<i>Goodyera oblongifolia</i>	Western rattlesnake plantain
GYDR	<i>Gymnocarpium dryopteris</i>	Oak fern
HADI2	<i>Habenaria dilatata</i>	White bog-orchid
HAL	<i>Hieracium albiflorum</i>	White flowered hawkweed
HOLA	<i>Holcus lanatus</i>	Velvet grass
HYTE	<i>Hydrophyllum tenuipes</i>	Slender-stemmed waterleaf
HYRA	<i>Hypochaeris radicata</i>	Hairy cat's ear
HYMO	<i>Hypopitys monotropa</i>	Pinesap
JUEF	<i>Juncus effusus</i>	Common rush
LAMU	<i>Lactuca muralis</i>	Wall lettuce
LIBO2	<i>Linnaea borealis</i>	Twinflower
LICA2	<i>Lister caurina</i>	Northwest listera
LICO2	<i>Listera convallarioides</i>	Broad-lipped twayblade
LICO3	<i>Listera cordata</i>	Heart-leaf twayblade
LUPA	<i>Luzula parviflora</i>	Small flowered woodrush
LYCL	<i>Lycopodium clavatum</i>	Ground pine
LYAM	<i>Lysichitum americanum</i>	Skunk cabbage
MADI	<i>Maianthemum dilatatum</i>	Beadruby
MESU	<i>Melica subulata</i>	Alaska oniongrass
MIBR	<i>Mitella breweri</i>	Brewer's mitrewort
MOSI	<i>Montia siberica</i>	Candyflower
OSCH	<i>Osmorhiza chilensis</i>	Mountain sweet-cicely

TRI code	Scientific Name	Common Name
OXOR	<i>Oxalis oregana</i>	Oregon oxalis
PERA	<i>Pedicularis racemosa</i>	Leafy lousewort
PEFR	<i>Petasites frigidus</i>	Sweet coltsfoot
PHPR	<i>Phleum pratense</i>	Common timothy
POPR	<i>Poa pratense</i>	Kentucky bluegrass
POGL4	<i>Polypodium glycyrrhiza</i>	Licorice fern
POMU	<i>Polystichum munitum</i>	Swordfern
PRVU	<i>Prunella vulgaris</i>	Self-heal
PTAQ	<i>Pteridium aquilinum</i>	Bracken fern
PTAN	<i>Pterospora andromedea</i>	Pinedrops
PYAS	<i>Pyrola asarifolia</i>	Common pink pyrola
PYPI	<i>Pyrola picta</i>	Whitevein pyrola
PYSE	<i>Pyrola secunda</i>	One-sided pyrola
PYUN	<i>Pyrola uniflora</i>	Woodnymph
RARE	<i>Ranunculus repens</i>	Creeping buttercup
RULA	<i>Rubus lasiococcus</i>	Dwarf bramble, trailing b.
RUNI	<i>Rubus nivalis</i>	Snow bramble
RUPE	<i>Rubus pedatus</i>	Five-leaved bramble, trailing b.
RUUR	<i>Rubus ursinus</i>	Pacific blackberry
RUAC	<i>Rumex acetosella</i>	Sheep sorrel
SEJA	<i>Senecio jacobaea</i>	Tansy ragwort
SESY	<i>Senecio sylvaticus</i>	Wood groundsel
SMRA	<i>Smilacina racemosa</i>	Large false solomon seal
SMST	<i>Smilacina stellata</i>	Small false solomon seal
STME2	<i>Stachys maxicana</i>	Mexicana, hedge-nettle
STCA2	<i>Stellaria calycantha</i>	Thick-leaved starwort
STAM	<i>Streptopus amplexifolius</i>	Clasping-leaved twisted-stalk
STRO	<i>Streptopus roseus</i>	Rosy twisted-stalk
TITR	<i>Tiarella trifoliata</i>	Theree-leaved foamflower
TIUN	<i>Tiarella unifoliata</i>	One-leaved foamflower
TOME	<i>Tolmiea menziesii</i>	Yount-on-age, Pig-a-back
TRLA2	<i>Trientalis latifolia</i>	Broad-leaved starflower
TROV	<i>Trillium ovatum</i>	White trillium, Wakerobin
TRCA	<i>Trisetum canescens</i>	Tall trisetum
TRCE	<i>Trisetum cernuum</i>	Nodding trisetum
TRSP	<i>Trisetum spicatum</i>	Spike trisetum
URDI	<i>Urtica dioica</i>	Stinging nettle
VASI	<i>Valeriana sitchensis</i>	Sitka valerian
VAHE	<i>Vancouveria hexandra</i>	Inside-out flower
VECH	<i>Veronica chamaedrys</i>	Speedwell
VIGL	<i>Viola glabella</i>	Pioneer violet
WISE	<i>Viola sempervirens</i>	Evergreen violet
XETE	<i>Xerophyllum tenax</i>	Common beargrass

TABLE X. COMMONLY OCCURRING PLANTS OF NON-FORESTED HABITATS, MT.
BAKER-SNOQUALMIE NATIONAL FOREST

SHRUBS

TRI Code	Scientific Name	Common Name
ACCI	<i>Acer circinatum</i>	Vine maple
ALSI	<i>Alnus sinuata</i>	Sitka alder
AMAL	<i>Amelanchier alnifolia</i>	Serviceberry
ARUV	<i>Arctostaphylos uva-ursi</i>	Bearberry, Kinnikinnick
BENE	<i>Berberis nervosa</i>	Low Oregon grape
CAME	<i>Cassiope mertensiana</i>	White Mt. heather
CLPY	<i>Cladothamnus pyroliflorus</i>	Copper-bush
JUCO4	<i>Juniperus communis</i>	Common juniper
KAMI	<i>Kalmia microphylla</i>	Alpine laurel, small leaved laurel
KAOC	<i>Kalmia occidentalis</i>	Western Swamp laurel
MEFE	<i>Menziesia ferruginea</i>	Rusty menziesia, Fool's huckleberry
OPHO	<i>Oplopanax horridum</i>	Devil's club
PAMY	<i>Pachystima myrsinites</i>	Myrtle pachystima, Mt. lover
PHEM	<i>Phyllodoce empetriformis</i>	Red mountain heather
PREM	<i>Prunus emarginata</i>	Bitter cherry
RHAL	<i>Rhododendron albiflorum</i>	Cascades azalea, white rhododendron
RIBR	<i>Ribes bracteosum</i>	Stinking black currant
RIHO	<i>Ribes howellii</i>	Mapleleaf currant
RILA	<i>Ribes lacustre</i>	Prickly currant
ROGY	<i>Rosa gymnocarpa</i>	Baldhip rose
RUPA	<i>Rubus parviflorus</i>	Western thimbleberry
RUSP	<i>Rubus spectabilis</i>	Salmonberry
SARA	<i>Sambucus racemosa</i>	Red elderberry
SOSI	<i>Sorbus sitchensis</i>	Sitka mountain ash
SPDE	<i>Spiraea densiflora</i>	Subalpine spiraea
SPDO	<i>Spiraea douglasii</i>	Douglas spiraea
VAAL	<i>Vaccinium alaskaense</i>	Alaska huckleberry
VACA	<i>Vaccinium caespitosum</i>	Dwarf huckleberry
VADE	<i>Vaccinium deliciosum</i>	Blue-leaf huckleberry
VAME	<i>Vaccinium membranaceum</i>	Thin-leaved huckleberry
VAOV	<i>Vaccinium ovalifolium</i>	Oval-leaf huckleberry
VASC	<i>Vaccinium scoparium</i>	Grouse whortleberry

HERBS

ACMI	<i>Achillea millefolium</i>	Western yarrow
ACTR	<i>Achlys triphylla</i>	Vanillaleaf
AGAU	<i>Agoseris aurantiaca</i>	Orange agoseris or false dandelion
AGEX	<i>Agrostis exarata</i>	Spike bentgrass
AGID	<i>Agrostis idahoensis</i>	Idaho bentgrass
AGHU	<i>Agrostis humilis</i>	Alpine bentgrass
AGOR	<i>Agrostis oregonensis</i>	Oregon bentgrass
AGSC	<i>Agrostis scabra</i>	Winter bentgrass, rough hairgrass
ANAR2	<i>Angelica arguta</i>	Lyall's or sharptooth angelica
ANCA	<i>Angelica canbyi</i>	Candy's angelica

TRI Code	Scientific Name	Common Name
ANGE	<i>Angelica genuflexa</i>	Kneeling angelica
ANMA	<i>Anaphalis margaritacea</i>	Common pearly-everlasting
ANOC	<i>Anemone occidentalis</i>	Western pasque flower
ANMI2	<i>Antennaria microphylla</i>	Rosy pussy-toes
AQFO	<i>Aquilegia formosa</i>	Red columbine
ARLA	<i>Arnica latifolia</i>	Broadleaf arnica
ARTR3	<i>Artemisia trifurcata</i>	Three forked artemisia
ARSY	<i>Aruncus sylvester</i>	Sylan goatsbeard
ASCA3	<i>Asarum caudatum</i>	Wild ginger
ASLE2	<i>Aster ledophyllus</i>	Cascade aster
ATFI	<i>Athyrium filix-femina</i>	Lady fern
BLSP	<i>Blechnum spicant</i>	Deer fern
BOEL	<i>Boykinia elata</i>	Slender boykinia
BRVU	<i>Bromus vulgaris</i>	Common brome
CACA	<i>Calamagrostis canadensis</i>	Bluejoint reedgrass
CABI	<i>Caltha biflora</i>	White marshmarigold
CAR03	<i>Campanula rotundifolia</i>	Scotch bellflower, lady's thimble
CAAQ	<i>Carex aquatilis</i>	Water sedge
CADE	<i>Carex deweyana</i>	Dewey's sedge
CAGE	<i>Carex geyeri</i>	Elk sedge
CAIN5	<i>Carex interior</i>	Inland sedge
CALE5	<i>Carex lenticularis</i>	Lenticular sedge
CAME2	<i>Carex mertensii</i>	Merten's sedge
CAMI2	<i>Carex nigricans</i>	Black alpine sedge
CAPH	<i>Carex phaeocephala</i>	Dunhead sedge
CARO	<i>Carex rossii</i>	Ross' sedge
CASA2	<i>Carex saxatilis</i>	Russet sedge
CASP	<i>Carex spectabilis</i>	Showy sedge
CAVE	<i>Carex vesicaria</i>	Inflated sedge
CAMI2	<i>Castilleja miniata</i>	Scarlet paintbrush
CAPA3	<i>Castilleja parviflora</i>	Magenta paintbrush
CIAL	<i>Circaea alpina</i>	Enchanter's nightshade
CIED	<i>Cirsium edule</i>	Edible thistle
CLLA	<i>Claytonia lanceolata</i>	Western spring beauty
CLUN	<i>Clintonia uniflora</i>	Queen's cup, bead lily
COCA	<i>Cornus canadensis</i>	Bunchberry
COSC	<i>Corydalis scouleri</i>	Scouler's corydalis
CRCR	<i>Cryptogramma crispa</i>	Parsley fern
DAIN	<i>Danthonia intermedia</i>	Timber danthonia or oatgrass
DEGL2	<i>Delphinium glareosum</i>	Rockslide larkspur
DEAT	<i>Deschampsia atropurpurea</i>	Mountain harigrass
DIFO	<i>Dicentra formosa</i>	Pacific bleedingheart
DIHO	<i>Digitalis purpurea</i>	Foxglove
DIPU	<i>Disporum hookeri</i>	Hooker's fairbell
DISM	<i>Disporum smithii</i>	Smith fairybell
DOJE	<i>Dodecatheon jeffreyi</i>	Jeffrey's shooting star
DRRO	<i>Drosera rotundifolia</i>	Sundew
DRAU2	<i>Dryopteris austriaca</i>	Spreading woodfern
ELPA	<i>Eleocharis palustris</i>	Common or creeping spike-rush
ELGL	<i>Elymus glaucus</i>	Blue wildrye
EPAL	<i>Epilobium alpinum</i>	Alpine willow-herb
EPAN	<i>Epilobium angustifolium</i>	Fireweed
EPGL	<i>Epilobium glaberrimum</i>	Common willow-herb

TRI Code	Scientific Name	Common Name
EQAR	<i>Equisetum arvense</i>	Common horsetail
ERPE	<i>Erigeron peregrinus</i>	Subalpine daisy
ERPO2	<i>Eriophorum polystachion</i>	Many spiked cotton-grass
ERMO	<i>Erythronium montanum</i>	Avalanche fawn-lily
FEVI	<i>Festuca viridula</i>	Green fescue
FRVI	<i>Fragaria virginiana</i>	Broadpetal strawberry
GAAP	<i>Galium aparine</i>	Catchweed bedstraw
GATR	<i>Galium triflorum</i>	Fragrant bedstraw
GECA	<i>Gentiana calycosa</i>	Explorer gentian, Mt. bog gentian
GLEL	<i>Glyceria elata</i>	Tall mannagrass
GYDR	<i>Gymnocarpium dryopteris</i>	Oak fern
HADI2	<i>Habenaria dilatata</i>	White bog orchid
HASA	<i>Habenaria saccata</i>	Slendar bog-orchid
HELA	<i>Heracleum lanatum</i>	Cow parsnip
HIAL	<i>Hieracium albiflorum</i>	White flowered hawkweed
HIGR	<i>Hieracium gracile</i>	Western hawkweed
HYFE	<i>Hydrophyllum fendleri</i>	Pacific waterleaf
HYTE	<i>Hydrophyllum tenuipes</i>	Slender-stemmed waterleaf
HYAN	<i>Hypericum anagalloides</i>	Trailing St. Johnswort
JUDR	<i>Juncus drummondii</i>	Drummond rush
JUEF	<i>Juncus effusus</i>	Common rush
JUEN	<i>Juncus ensifolius</i>	Swordleaf rush
JUKE	<i>Juncus kelloggii</i>	Kellogg's rush
JUME	<i>Juncus mertensianus</i>	Merten's rush
JUPA	<i>Juncus parryi</i>	Parry rush
LEPY2	<i>Leptarrhena pyrolifolia</i>	False saxifrage
LICA2	<i>Ligusticum canbyi</i>	Canby licoriceroot or lovage
LIGR	<i>Ligusticum grayii</i>	Gray's licoriceroot or lovage
LICO4	<i>Lilium columbianum</i>	Columbia lily
LOMA2	<i>Lomatium martindalei</i>	Martindale's lomatium
LUPE	<i>Luetkea pectinata</i>	Partridge foot
LUST	<i>Luina stricta</i>	Tongue-leaf luina
LULA	<i>Lupinus latifolius</i>	Broadleaf lupine
LUCA2	<i>Luzula campestris</i>	Field woodrush
LUPA	<i>Luzula parviflora</i>	Millet woodrush
LYAM	<i>Lysichitum americanum</i>	Skunk cabbage
MADI	<i>Maianthemum dilatatum</i>	Beadruby
METR	<i>Menyanthes trifoliata</i>	Common bogbean
MEPA	<i>Mertensia paniculata</i>	Panicle bluebells
MIBR	<i>Mitella breweri</i>	Brewer's mitrewort
MIOV	<i>Mitella ovalis</i>	Oval-leaved mitrewort
MOSI	<i>Montia sibirica</i>	Candyflower
NONE	<i>Nothochelone nemorosa</i>	Woodland beardtongue
NUPO	<i>Nuphar polysepala</i>	Yellow waterlily
OESA	<i>Oenante sarmentosa</i>	Pacific waterdropwort
OSCH	<i>Osmorhiza chilensis</i>	Mountain sweet-cicely
PEBR	<i>Pedicularis bracteosa</i>	Bracted lousewort
PECO2	<i>Pedicularis contorta</i>	White coiled-beak lousewort
PEGR	<i>Pedicularis groenlandica</i>	Pink elephants, elephant's head
PEOR5	<i>Pedicularis ornithorhynca</i>	Bird's-beak pedicularis
PEDA	<i>Penstemon davidsonii</i>	Davidson's penstemon
PHAL	<i>Phleum alpinum</i>	Alpine timothy

TRI Code	Scientific Name	Common Name
PHPR	<i>Phleum pratense</i>	Timothy
PHDI	<i>Phlox diffusa</i>	Spreading phlox
PIVU	<i>Pinguicula vulgaris</i>	Common butterwort
POPU	<i>Polemonium pulcherrimum</i>	Skunkleaf polemonium or Jacob's Ladder
POBI	<i>Polygonum bistortoides</i>	American bistort
POFL2	<i>Potentilla flabellifolia</i>	Fanleaf cinquefoil
PONA2	<i>Potamogeton nataus</i>	Flouting leaved pondweed
PTAQ	<i>Pteridium aquilinum</i>	Braken fern
PUPA	<i>Paccinellia pauciflora</i>	Weak alkaligrass
RAAL	<i>Ranunculus alismaefolias</i>	Plantainleaf buttercup
RAES	<i>Ranunculus eschscholtzii</i>	Subalpine buttercup
RULA	<i>Rubus lasiococcus</i>	Dwarf bramble, Trailing bramble
RUPE	<i>Rubus pedatus</i>	Five-leaved bramble, Trailing bramble
RUUR	<i>Rubus ursinus</i>	Pacific blackberry
RUAC	<i>Rumex acetocella</i>	Sheep sorrel, Sour weed
RUOB	<i>Rumex obtusifolius</i>	Bitter dock, Broadleaved dock
SASI	<i>Sanguisorba sitkensis</i>	Sitka burnet
SAAM	<i>Saussurea americana</i>	American sawwort
SAFE	<i>Saxifraga ferruginea</i>	Rusty saxifrage
SAPU	<i>Saxifraga punctata</i>	Dotted saxifrage
SCMI	<i>Scirpus microcarpus</i>	Small fruited bullrush, panicle bullrush
SEDI	<i>Sedum divergens</i>	Spreading stonecrop
SETR	<i>Senecio triangularis</i>	Arrowleaf groundsel
SIPA	<i>Silene parryi</i>	Parry's silene
SMRA	<i>Smilacina racemosa</i>	Western solomon-plume, large false solomon seal
SMST	<i>Smilacina stellata</i>	Starry solomon-plume, small false solomon seal
SPAN	<i>Sparganium angustifolium</i>	Narrowleaf burreed
STME2	<i>Stachys mexicana</i>	Mexicana betony or hedge nettle
STCR	<i>Stellaria crispa</i>	Crisped starwort
STAM	<i>Streptopus amplexifolius</i>	Clasping-leaved twisted stalk
STRO	<i>Streptopus roseus</i>	Rosy twisted-stalk
TAOF	<i>Taraxacum officianale</i>	Common dandelion
TITR	<i>Tiarella trifoliata</i>	Three-leaved foamflower
TIUN	<i>Tiarella unifoliata</i>	One-leaved foamflower
TOGL	<i>Tofieldia glutinosa</i>	Sticky tofieldia
TOME	<i>Tolmiea menziesii</i>	Youth-on-age, Pig-a-back
TRLA2	<i>Trientalis latifolia</i>	Broad-leaved starflower
TRRE	<i>Trifolium repens</i>	Dutch clover
TROV	<i>Trillium ovatum</i>	White trillium, Wakerobin
TRCE	<i>Trisetum cernuum</i>	Nodding trisetum
TRSP	<i>Trisetum spicatum</i>	Spike trisetum
URDI	<i>Urtica dioica</i>	Nettle
VASI	<i>Valeriana sitchensis</i>	Sitka valerian
VEVI	<i>Veratrum viride</i>	Green false hellebore
VEAN	<i>Veronica anagallis-aquatica</i>	Water speedwell
VECU	<i>Veronica cusickii</i>	Cusick's speedwell
VEWO	<i>Veronica wormskjoldii</i>	American alpine speedwell
VIGL	<i>Viola glabella</i>	Pioneer violet
WISE	<i>Viola sempervirens</i>	Evergreen violet
XETE	<i>Xerophyllum tenax</i>	Common beargrass

1 Mountain hemlock (TSME) $\geq 10\%$ cover.....	(2)		
2 Devils club (OPHO) $\geq 5\%$ cover.....	TSME/OPHO	p. 29	
2 Devils club (OPHO) $< 5\%$ cover.....	(3)		
3 Marsh marigold (CABI) $\geq 10\%$ cover.....	TSME/CABI	p. 29	
3 Marsh marigold (CABI) $< 10\%$ cover.....	(4)		
4 Big huckleberry (VAME) $\geq 20\%$ cover.....	(5)		
5 Red heather (PHEM) plus blueleaf huckleberry (VADE) $\geq 25\%$ cover.....	TSME/PHEM-VADE	p. 31	
5 Red heather (PHEM) plus blueleaf huckleberry (VADE) $< 25\%$ cover.....	(6)		
6 Alaska huckleberry (VAAL + VAOV) $\geq 10\%$ cover.....	TSME/VAAL-VAME	p. 33	
6 Alaska huckleberry (VAAL + VAOV) $< 10\%$ cover.....	TSME/VAME	p. 33	
4 Big huckleberry (VAME) $< 20\%$ cover.....	(7)		
7 Foamflower (TIUN + TITR) plus rosy twisted stalk (STRO) $\geq 10\%$ cover.....	TSME/TIUN-STRO	p. 29	
7 Not as above.....	(8)		
8 White rhododendron (RHAL) $\geq 5\%$ cover.....	(9)		
9 Red heather (PHEM) $\geq 10\%$ cover.....	TSME/RHAL-PHEM	p. 31	
9 Red heather (PHEM) $< 10\%$ cover and big huckleberry (VAME) $\geq 5\%$ cover.....	TSME/RHAL-VAME	p. 30	
8 White rhododendron (RHAL) $< 5\%$ cover.....	(10)		
10 Red heather (PHEM) plus blueleaf huckleberry (VADE) $\geq 25\%$ cover.....	TSME/PHEM-VADE	p. 31	
10 Red heather (PHEM) plus blueleaf huckleberry (VADE) $< 25\%$ cover.....	(11)		
11 Big huckleberry (VAME) $\geq 10\%$ cover.....	(12)		
12 Alaska huckleberry (VAAL + VAOV) $\geq 10\%$ cover.....	TSME/VAAL-VAME	p. 33	
12 Alaska huckleberry (VAAL + VAOV) $< 10\%$ cover.....	TSME/VAME	p. 33	
11 Big huckleberry (VAME) $< 10\%$ cover.....	(13)		
13 Alaska huckleberry (VAAL + VAOV) $\geq 10\%$ cover.....	TSME/VAAL	p. 35	
13 Understory (shrubs and herbs) $\leq 10\%$ cover.....	TSME/Depauperate	p. 37	
1 Mountain hemlock (TSME) $< 10\%$ cover.....	(14)		
14 Silver fir (ABAM) $\geq 10\%$ cover.....	(15)		
15 Big huckleberry (VAME) $\geq 10\%$ cover.....	ABAM/VAME	p. 42	
15 Big huckleberry (VAME) $< 10\%$ cover.....	(16)		
16 Alaska huckleberry (VAAL + VAOV) $\geq 10\%$ cover.....	(17)		
17 Devils club (OPHO) $\geq 5\%$ cover.....	ABAM/OPHO-VAAL	p. 45	
17 Devils club (OPHO) $< 5\%$ cover.....	(18)		
18 Salal (GASH) $\geq 5\%$ cover.....	ABAM/VAAL-GASH	p. 48	
18 Salal (GASH) $< 5\%$ cover.....	(19)		
19 LIBO2 and BENE both present and at least one $\geq 5\%$ cover.....	ABAM/VAAL/LIBO2	p. 49	
19 Not as above.....	(20)		
20 Foamflower (TIUN + TITR) $< 5\%$ cover.....	ABAM/VAAL	p. 46	
20 Foamflower (TIUN + TITR) $\geq 5\%$ cover.....	(21)		
21 Alaska huckleberry (VAAL + VAOV) $\leq 20\%$ cover.....	ABAM/TIUN	p. 50	
21 Alaska huckleberry (VAAL + VAOV) $> 20\%$ cover.....	ABAM/VAAL	p. 46	
16 Alaska huckleberry (VAAL + VAOV) $< 10\%$ cover.....	(22)		
22 Devils club (OPHO) $\geq 5\%$ cover.....	ABAM/OPHO	p. 43	
22 Devils club (OPHO) $< 5\%$ cover.....	(23)		
23 Swordfern (POMU) $\geq 5\%$ cover.....	ABAM/POMU	p. 51	
23 Swordfern (POMU) $< 5\%$ cover.....	(24)		
24 Foamflower (TIUN + TITR) $\geq 5\%$ cover.....	ABAM/TIUN	p. 50	
24 Foamflower (TIUN + TITR) $< 5\%$ cover.....	(25)		
25 Oregon grape (BENE) $\geq 5\%$ cover.....	ABAM/BENE	p. 52	
25 Oregon grape (BENE) $< 5\%$ cover.....	(26)		
26 LIBO2 $\geq 10\%$ cover and VAAL or VAOV present.....	ABAM/VAAL/LIBO2	p. 49	
26 Not as above.....	(27)		
27 Alaska huckleberry (VAAL + VAOV) $\geq 5\%$ cover.....	ABAM/VAAL	p. 46	
27 Alaska huckleberry (VAAL + VAOV) $< 5\%$ cover.....	(28)		
28 Five-leaved bramble (RUPE) $\geq 10\%$ cover.....	ABAM/RUPE	p. 44	
28 Understory except vine maple (ACCI) $\leq 10\%$ cover.....	ABAM/Depauperate	p. 53	
14 Silver fir (ABAM) $< 10\%$ cover, western hemlock (TSME) climax indicator.....	(29)		
29 Skunk cabbage (LYAM) $\geq 5\%$ cover.....	TSME/LYAM	p. 71	
29 Skunk cabbage (LYAM) $< 5\%$ cover.....	(30)		
30 Devils club (OPHO) $\geq 5\%$ cover.....	TSME/OPHO	p. 59	
30 Devils club (OPHO) $< 5\%$ cover.....	(31)		
31 Alaska huckleberry (VAAL + VAOV) $\geq 10\%$ cover.....	TSME/VAAL	p. 63	
31 Alaska huckleberry (VAAL + VAOV) $< 10\%$ cover.....	(32)		
32 Swordfern (POMU) $\geq 10\%$ cover.....	(33)		
33 Foamflower (TITR + TIUN) $\geq 5\%$ cover.....	TSME/POMU-TITR	p. 69	
33 Foamflower (TITR + TIUN) $< 5\%$ cover.....	(34)		
34 Salal (GASH) $\geq 10\%$ cover.....	TSME/POMU-GASH	p. 62	
34 Salal (GASH) $< 10\%$ cover.....	(35)		
35 Oregon grape (BENE) $\geq 5\%$ cover.....	TSME/POMU-BENE	p. 70	
35 Oregon grape (BENE) $< 5\%$ cover.....	TSME/POMU	p. 64	
32 Swordfern (POMU) $< 10\%$ cover.....	(36)		
36 Salal (GASH) $\geq 10\%$ cover.....	(37)		
37 Swordfern (POMU) $\geq 3\%$ cover.....	TSME/POMU-GASH	p. 62	
37 Swordfern (POMU) $< 3\%$ cover.....	TSME/GASH	p. 60	
36 Salal (GASH) $< 10\%$ cover.....	(38)		
38 Alaska huckleberry (VAAL + VAOV) $\geq 5\%$ cover.....	TSME/VAAL	p. 63	
38 Alaska huckleberry (VAAL + VAOV) $< 5\%$ cover.....	(39)		
39 Oregon grape (BENE) $\geq 5\%$ cover.....	(40)		
40 Swordfern (POMU) $\geq 3\%$ cover.....	TSME/POMU-BENE	p. 70	
40 Swordfern (POMU) $< 3\%$ cover.....	TSME/BENE	p. 66	
39 Oregon grape (BENE) $< 5\%$ cover.....	(41)		
41 Foamflower (TITR + TIUN) and oakfern (GYDR) each $\geq 2\%$ cover.....	TSME/TITR-GYDR	p. 68	
41 Foamflower (TITR + TIUN) or oakfern (GYDR) $< 2\%$ cover.....	(42)		
42 Vine maple (ACCI) $\geq 10\%$ cover.....	(43)		
43 Oregon grape (BENE) present.....	TSME/BENE	p. 66	
43 Oregon grape (BENE) absent.....	TSME/Depauperate	p. 67	
42 Vine maple (ACCI) $< 10\%$ cover.....	TSME/Depauperate	p. 67	